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AN EXPERIMENTAL STUDY OF INTRAPERITONEAL DIFFUSION

WITH REFERENCE TO TOXIN ABSORPTION

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THE experiments here reported were undertaken to ascertain the effect of variations in bodily position and in gastrointestinal activity upon the degree and extent of diffusion of benign and toxic substances when introduced intraperitoneally as a suspension or solution; also to determine the influence of the degree of diffusion upon the absorption of toxins.

The subject will be considered under the following headings:

1. Methods.
2. Experiments: *a.* Lamp black; *b.* Moccasin venom; *c.* Cobra venom.
3. Discussion.
4. Conclusions.
5. Clinical significance.

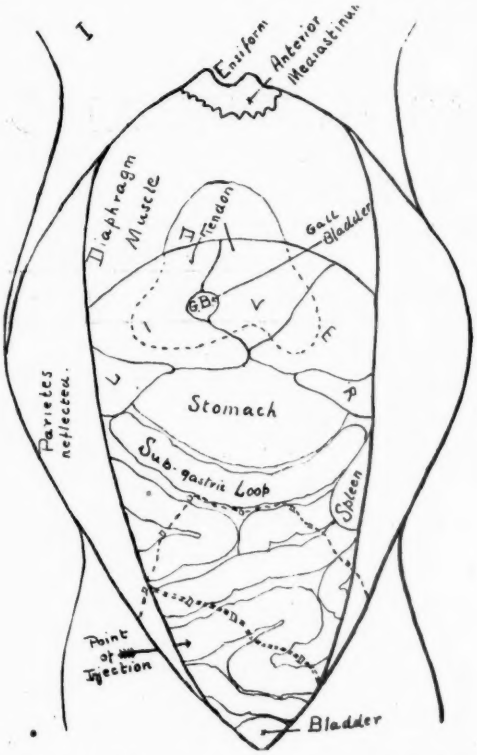
Dogs were selected as the experimental animals best suited to the requirements of the problem. Great dissimilarity in size and condition of the animals was avoided, the average weight being nine kilograms.

METHODS

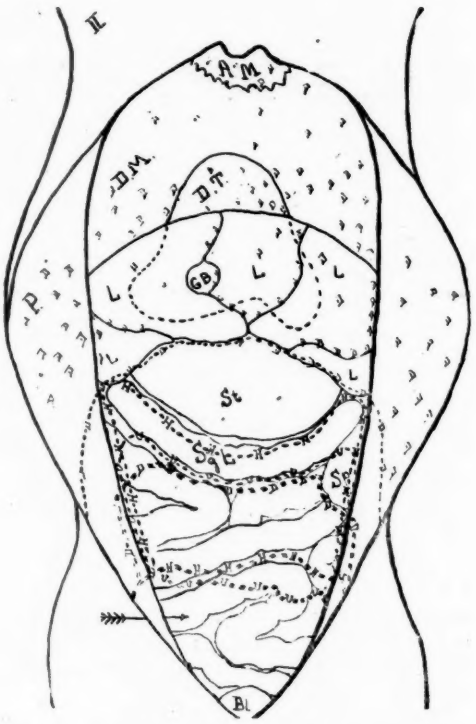
Position. Three dorsal positions were employed, (*a*) horizontal, and inclined, (*b*) with head elevated, and (*c*) with head depressed. Two "beds" were constructed upon one board so supported that when one end was lowered to the floor there resulted an angle of 30° with the horizontal. The animals were generally prepared in a horizontal position and the inclination promptly established after injection. When practicable the experiments were carried out in sets of three with the purpose of attaining the greatest possible similarity of conditions and the greatest accuracy in comparison.

Gastrointestinal Activity. Three sets of conditions affecting the alimentary canal were selected: (*a*) "fed" animals, employed 2–5 hours after feeding (when possible both liquid and solid foods were given); (*b*) "starved" animals, 24 hours after purge and emesis; (*c*) "morphinized" animals, 2–3 hours after hypodermic injection. The conditions in the morphine animals were most uniform. The drug was given in 1½ grain doses which provoked prompt emesis and catharsis, usually completely emptying both stomach and rectum. The starved dogs were given 1½ grains of morphine as a purge and emetic at the beginning of a 24-hour period of fasting. Prior to the end of this period the effects of the drug had disappeared. The fed dogs fasted 12–24 hours previous to the final feeding.

Injections. The injections were given intraperitoneally in the lower right abdominal quadrant (at the outer margin of the rectus muscle and on a level with the crest of the ilium) in doses of 4–5 ccm., the minimum volume being employed in the case of animals below the average size. The liquid was introduced at body temperature and as constantly as possible in force and direction.



Diag. 1. Schematic representation of a dog's belly viewed from below. Double dotted (D) line is the limit of primary diffusion of lamp black and the single dotted (D) line limit of secondary diffusion after 30 minutes in a dead dog in a horizontal position. Secondary diffusion is highest in median line.



Diag. 2. Fed Dogs — Lamp black, 30 minutes. Double dotted lines (U. H. & D.) indicate limits of primary diffusion in head-up, horizontal and head-down positions. Single dotted (U. H. D.) lines limits of secondary diffusion. Isolated letters (U. H. D.) indicate tertiary diffusion in corresponding positions. Secondary diffusion in horizontal position higher in flanks than median line.

Injection Material. Lamp black in a dense but fine suspension in 0.85 per cent saline solution was used as the benign substance, and the dried venoms of the water moccasin (Ancistrodon piscivorus) and cobra (Naja tripudians) in 0.2 per cent and 2 per cent solutions in normal saline, as toxins. The venoms were particularly desirable toxins since structurally and physiologically they bear a close analogy to bacterial toxins and are relatively stable. The venom of the moccasin was used in sub-lethal doses as a local irritant to the serosa merely to determine the area of diffusion as indicated by the inflammatory reaction. The cobra venom in lethal doses was employed to determine the rate of absorption of the toxin from the peritoneal cavity as revealed by the intoxication phenomena and to determine the relation of this rate to the extent and intensity of the local reaction as observed post mortem.

Protocols. This report is based upon results obtained in seventy-five experiments. In addition to the usual notes the post-mortem findings were recorded graphically upon schematic diagrams of a dog's abdomen.

EXPERIMENTS

Duration of Experiments. It was impossible to restrain normal dogs comfortably in a dorsal position for long periods, and as strug-

LAMP BLACK, 4-5 CCM., 30 MINUTES. DIAGRAMS I, II, III, AND IV

Group.	Class.	Upper Limits of Areas of Diffusion			Remarks
		Primary	Secondary	Tertiary	
Horizontal.	Dead.	Lowest one-third of belly.	To subgastric loop.	None.	Secondary diffusion highest in the median line.
Head up.	Fed.	Lowest one-third of belly.	To subgastric loop.	None.	
Head up.	Starved.	Lowest one-third of belly.	To subgastric loop.	None.	
Head up.	Morph.	Lowest one-third of belly.	Lowest one-third of belly.	None.	Diffusion even less in amount than in extent.
Horizontal.	Fed.	Lowest one-third of belly.	To greater curvature.	None.	Secondary diffusion higher in flanks than in medianline.
Horizontal.	Starved.	Lowest one-third of belly.	To greater curvature.	Suggestion at pylorus.	
Horizontal.	Morph.[1]	Lowest one-third of belly.	Upon subgastric loop.	None.	Compare with results in dead dog, Diagram 1; secondary diffusion here higher in flanks.
Head down.	Fed.	To subgastric loop.[2]	Upon stomach.	Upon parietes, liver, diaphragm muscle and tendon-mediastenum.	Parietes always involved to some extent. The diagram merely indicates the unusual excess.
Head down.	Starved.	To subgastric loop.	Upon stomach.	Upon lower aspect liver.	
Head down.	Morph.	Upon subgastric loop.	Upon stomach.	Few specks upon liver in flanks. One on central tendon of diaphragm.	

[1] In two other experiments upon morphinized dogs in the horizontal position lamp black was given with irritants, (1) Abrin, which caused no increase in the peritoneal fluid and (2) turpentine, which did. The distribution of the pigment was quite similar under all these conditions. This point has important bearing upon later considerations.

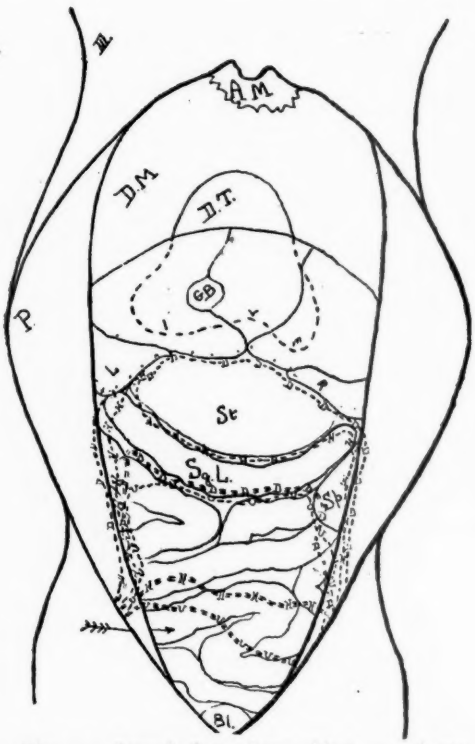
[2] In another experiment upon a fed dog in the horizontal position, there was almost continuous struggling, which produced tertiary diffusion similar to this in extent though less in amount.

gling complicated the problem it was hoped that the basic phenomena involved might promptly be manifested. The animals injected with lamp black and moccasin venom were killed with chloroform at the end of thirty minutes, those receiving cobra venom were allowed to succumb to the intoxication unless counter-indications arose, when these animals too were chloroformed. Certain elements in both of the venoms had a narcotizing effect, so that the actual discomfort to the animal was slight.

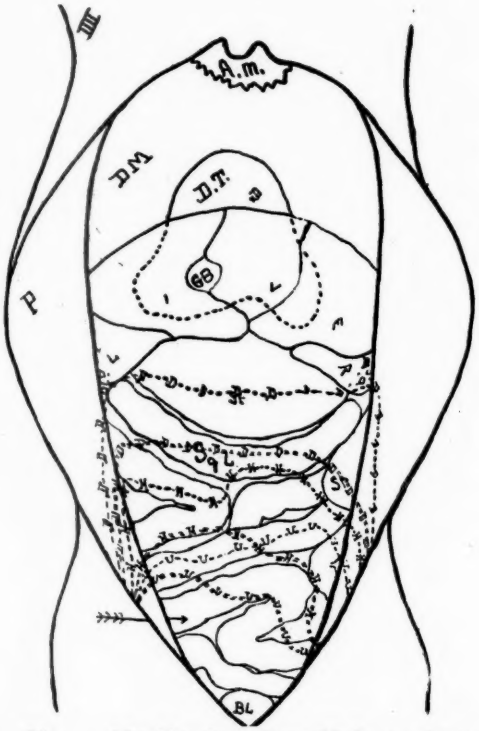
a. Lamp black. 4–5 ccm., 30 minutes.

General Nature of Findings. The results of the injections of lamp black suspension had certain constant features. The main mass of the lamp black remained near the site of injection and its distribution will be regarded as the area of main or primary diffusion. Extending directly from this area of primary diffusion was another well-defined area containing noticeably less of the pigment, which zone will be described as the area of secondary diffusion. These two areas were approximately confined to the infragastric regions of the abdomen, and were present in every experiment. In certain instances the pigment appeared at still more remote (supragastric) portions of the abdomen with or without any direct connection with the areas of primary or secondary diffusion. This extreme dissemination will be described as tertiary diffusion. Little difficulty attended the recognition of the limits of the primary and secondary areas, but in spite of precautions there remained a possibility of error in estimating the tertiary diffusion due to the mechanical dissemination of pigment particles at necropsy.

The diffusion, as shown by the distribution of lamp black particles, was both superficial between viscera and omentum or omentum and parietes, and deep between viscera and mesentery. Pathways of least resistance were found leading from the subgastric to the supragastric regions. These were at the region of the pylorus, thence upward along the gastrohepatic omentum, and in the flanks, particularly the lower if the animal had moved from the mid-dorsal position. The relative size and location of the omentum varied so little and complicating adhesions were so infrequent as to make these negligible sources of error. Evidently the location of the deposit of the injection mass primarily, whether preomental or retro-omental, would have great influence upon the subsequent diffusion, but as a matter of fact the injections were almost constantly retro-omental.



Diag. 3. Starved dogs. Lamp black 30 minutes. Lines and letters the same as in Diag. 2. Tendency of the secondary diffusion in the horizontal position to become tertiary at the pylorus.



Diag. 4. Morphine dogs. Lamp black, 30 minutes. Areas of secondary diffusion noticeably smaller than in Diags. 2 and 3. The distribution in the horizontal position similar to that in Diag. 1., (the same condition but in a dead animal) indicating the restriction of physiological activity.

The fluid represented by the menstruum of the lamp black suspension when injected into the retroperitoneal tissue was virtually absorbed in half an hour. Therefore, in view of the remarkable ability of the peritoneum to absorb salt solution, it may be assumed that in case of intraperitoneal injection the menstruum disappeared in much shorter time and the diffusion of lamp black took place under conditions approximately normal.

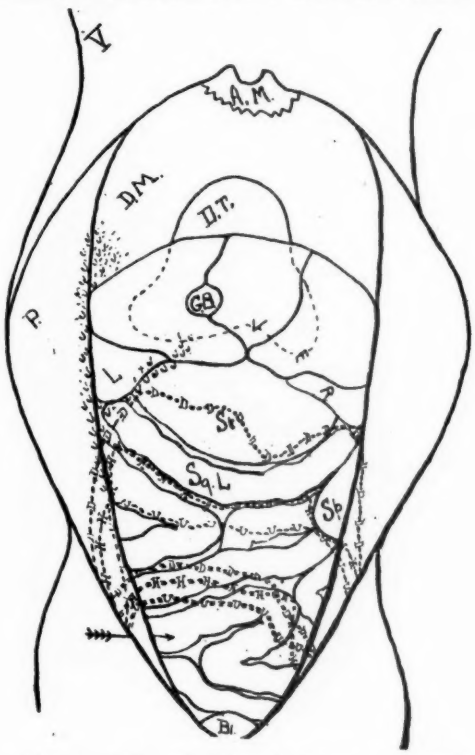
The results here recorded are from presumably typical experiments. They are grouped in the following table according to position of the animals and classified graphically in the diagrams according to conditions—fed, starved, or morphinized. Since the duration of the experiments was short and the amount of the injection mass was rather large compared to the size of the peritoneal cavity, the slightest variations in distribution become relatively significant. A reference to Diagram I will explain the nomenclature.

Summary. If the recorded observations made from a dead dog may be taken as illustrating purely physical diffusion, a comparison the results in the horizontal positions, Diagrams I to IV, apparently indicates that in living dogs primary diffusion is determined mainly by physical laws (capillarity, gravity), whereas, in secondary and tertiary diffusion physiological influences are relatively more important. In the dead dog the secondary spreading was highest in the median line, whereas, in the living animals it was constantly higher in flanks.

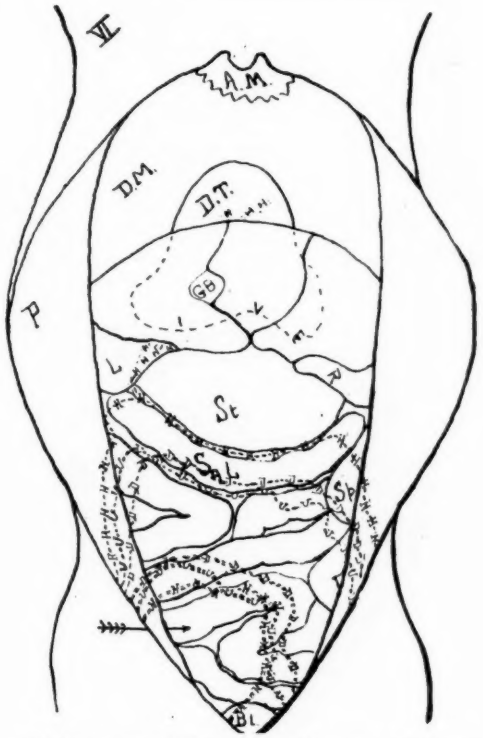
MOCCASIN VENOM — SUB-LETHAL DOSES — 30 MINUTES. DIAGRAMS V, VI, AND VII

Group	Class	Limits of Areas of Diffusion			Remarks
		Primary	Secondary	Tertiary	
Head up.	Fed.	Lowest one-third of belly.	Upon subgastric loop.	Via pylorus to gastrohepatic omentum, via right parietes to diaphragm.	This dog struggled excessively. The effect upon tertiary diffusion is very striking.
Head up.	Starved.	Lowest one-third of belly.	To subgastric loop.	None.	
Head up.	Morph.[1]	Lowest one-third of belly.	To subgastric loop.	None.	
Horizontal.	Fed.	Lowest one-third of belly.	To subgastric loop.	None.	
Horizontal.	Starved.	Lowest one-third of belly.	To greater curvature.	Via pylorus and gastrohepatic omentum to diaphragm.	This dog asthmatic. Marked effect of forced respiration upon tertiary diffusion —only instance where secondary diffusion in horizontal exceeds that in the down position.
Horizontal.	Morph.		To subgastric loop.	None.	Secondary diffusion less in amount than in extent.
Head down.	Fed.	Lowest one-third of belly.	To midgastric level.	None.	
Head down.	Starved.	Lowest one-third of belly.	Upon subgastric loop.	None.	
Head down.	Morph.	Lowest one-third of belly.	Upon subgastric loop.	Via pylorus and gastrohepatic omentum to the tendons of diaphragm.	Unusually slight reaction. Typical experiment. This degree of tertiary diffusion apparently possible under normal conditions.

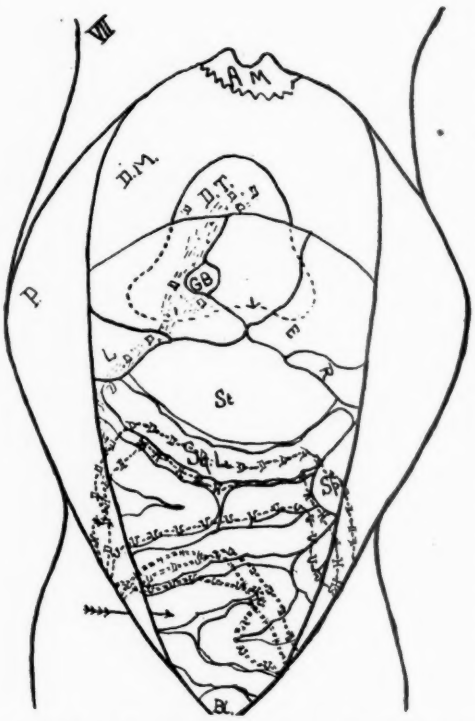
[1] Experiments in which venom was given in a lamp black suspension indicate that under these conditions the soluble toxin was more easily diffused primarily than the foreign bodies. In the head down position the distribution was virtually the same but at the end of a longer period.



Diag. 5. Fed dogs, Moccasin venom, 30 minutes. Areas of diffusion, sim lar to, but smaller than those in Diag. 2. Tertiary diffusion in experiment in head-up position due to struggling, and indicate paths of least resistance from the infragastric to supragastric regions.



Diag. 6. Starved Dogs. Moccasin venom, 30 minutes. Extensive diffusion in horizontal position due to labored breathing. Area of secondary reaction even higher than in the head-down position. Tertiary diffusion along the gastrohepatic omentum.



Diag. 7. Morphine Dogs. Moccasin venom, 30 minutes. Greater restriction of diffusion than is shown in Diags. 5 and 6, these results comparable to lamp black experiments. Tertiary extension in head-down position extended along gastrohepatic omentum to diaphragm.

Diffusion under the imposed conditions varies in both extent and amount and this variation appears proportional to the degree of variation in the conditions. This may be most easily appreciated by comparing the effects of position upon all classes of animals. There is little difference between the "head up" and horizontal groups compared to that between the "head up" and "head down" positions, similarly there is less difference between the fed and starved classes than between the fed and morphinized.

Diffusion of lamp black is restricted by a reduction of gastrointestinal activity, by somatic inactivity, and by opposing the action of gravity to the lines of greatest dissemination from the focus of injection. When the general and local inactivity is obtained by the administration of morphine in large doses the physiological factors influencing diffusion are largely eliminated and the physical predominate. The extent of diffusion is greatest with the "head down" and least with the "head up" position.

b. Moccasin venom. 30 minutes, Diagrams V, VI, and VII.

Moccasin venom marks its distribution intraperitoneally by the distinct local tissue reaction which it provokes. This reaction varies from the development of petechial and perivascular extravasations to extensive subserous hæmorrhages. It was determined that 0.05 ccm. of a 0.2 per cent solution (0.1 mg.) of the venom per kilogram of dog (well within the minimal lethal dose) was the dose suited for the production of a most distinct local reaction. With such doses there was constantly present an excess of peritoneal fluid containing a varying amount of free hæmoglobin. This increase in the amount of intraperitoneal fluid, coupled with the withdrawal of an amount of toxin by the tissues, resulted in a gradual decrease in the venom concentration of the fluid diffused; and this decrease in the activity of the fluid, together with the shorter time of its reaction with the areas last reached, resulted in zones varying in intensity of reaction. These zones of intensity were sufficiently constant and distinct to bear a direct analogy to the three degrees of diffusion observed in the lamp black experiments. The results of these experiments, therefore, will be recorded in the same way.

Summary. In general those factors which cause variations in the character and extent of the dissemination of a lamp black suspension may be assumed similarly to influence the diffusion of the moccasin venom in solution, if due allowances are made for the manifest differences in the nature and interpretation of the physiological responses, local and general, to these substances. In addition, labored respiration must be recognized as a factor favoring diffusion.

Observations made from all experiments upon which this report is based, including those in which the injections were made inadvertently more or less extraperitoneally and those used to determine the proper dosage, apparently indicate the existence of certain

fairly constant laws governing the reaction of the peritoneum to these toxin irritants.

Within limits, the intensity of the reaction is proportional to the amount of the irritant injected. When the same volume of solution is given, that containing the higher percentage of toxins produces the more intense reaction and the greater diffusion. If unequal volumes of the same percentage of venom are given, the smaller volume causes less diffusion though the intensity of the reaction is similar. When the amount of toxins produces more than a certain degree of reaction the diffusion is relatively less in extent.

The amount of excess fluid probably varies with the extent and intensity of the irritation within similar limits. This excess fluid so constantly extends beyond the limits of the reaction (notably in the experiments in the head down position) as to indicate that the action of the toxin is relatively intense upon the areas first reached, but that the toxin later becomes attenuated and provokes a less intense reaction at distant points. This assumption is upheld by the behavior of the animals during the experiments and by the fact that in all experiments, irrespective of position, the area of most intense reaction is about and *below* the site of injection.

The causation of the greater diffusion by greater irritation requires consideration because of subsequent bearing on this problem. Obviously it must result from the contact of toxins while in an active condition with a greater area of reactable serosa, which area is determined by physical and physiological phenomena. This may result from an immediate serous exudation which in effect increases the volume of the injection or it may result from increased peristalsis due to a direct or indirect stimulation of the intestinal muscles by the irritant.

c. Cobra venom. Lethal doses.

These experiments were undertaken to determine the relationship between the extent and severity of the local reaction (diffusion) and the rate and intensity of intoxication (absorption). A dose of venom which would kill in a relatively short time was expedient in order to make these results more directly comparable to those observed in the reaction to lamp black and moccasin venom. One-tenth of a cubic centimeter of a 2 per cent solution to each kilogram of dog was finally selected as the most satisfactory amount. Nine typical experiments (one for each of the three classes in each of the three positions) comprised one set or group. Two sets of eighteen dogs received this mean dose (0.1 cc. per kilogram). One set of nine dogs was given twice this amount and another set one half this dose. The general effects observed during these experiments compared to the post-mortem findings will be given as the basis from which conclusions may be drawn.

General Results. Immediate Effects. These were fairly constant in character and were more pronounced in the non-morphinized animals. There was immediate peritoneal pain of a few moments' duration succeeded by a morphine-like stupor. Urination, defæcation, and emesis or attempts at these acts, usually in that order, followed at varying intervals.

The heart rate was usually promptly accelerated. This was at times extreme and with it there was some irregularity. The respirations were also increased in frequency, occasionally panting but usually quiet and costal in character, in keeping with the rigid abdomen of peritoneal irritation.

Late Effects. The dogs continued in this condition, apparently in no discomfort, until the intoxication became more intense, when the heart reached its maximum rapidity followed by a rather sudden, often considerable, slowing, and at this stage irregularity was the rule. The respirations became shallower, slower, irregular, and gasping in character. They invariably ceased before the heart stopped beating, death resulting from failure of the respiratory center.

Duration of Life. Tables 1, 2, and 3.

It was determined by control experiments that when the venom was given subcutaneously similar phenomena of intoxication resulted but developed less rapidly.[1] Morphine conferred

[1] LENGTH OF LIFE IN MINUTES AFTER INJECTIONS OF COBRA VENOM

0.1 cc. of 2 per cent solution per kilogram.

Class	Fed	Starved	Morphine
Intraperitoneal	89	66	130
Subcutaneous	203	100	170

TABLE I. 36 Experiments

All doses - Average duration of life in minutes.

Groups	Fed	Starved	Morphine	Average
Up	114	70	190	125
Horizontal	96	88	142	109
Down	90	68	154	104
Average	100	76	162	113

no specific protection and starvation as here induced slightly decreased the normal resistance. As a standard of comparison the fed dogs may be taken as normal.

The average duration of life (Table 1) in the 36 experiments which were considered typical was 113 minutes. If the rate of absorption depends upon the area of contact with the peritoneum those conditions which restrict diffusion should give the greater duration of life. This is upheld by the average length of life in the three positions (head up 125, horizontal 109, and head down 104 minutes) but not by the 3 classes (morphine 162, starved 76, fed 100 minutes), when the starved might be expected to survive the fed. It is also noteworthy that the horizontal starved dogs lived the longest, that the morphine dogs in the head down position did better on the average than those in the horizontal posture and that the fed dogs followed the general average in length of life according to position.

An examination of the most rapidly fatal results (Table 2) indicates that the severity of the intoxication is fairly proportional to the size of the dose. Under these conditions the relationship between the suspected area of diffusion (determined in series 1 and 2) and the absorption is apparently still more questionable. In general the head down dogs outlived the horizontal (head up 67, head down 60, horizontal 56 minutes); the morphine class is still the longest and the starved still the shortest lived. Moreover, the morphine animals in the head down position did the best. The relationship in the other classes remains as in Table 1. From Table 3, showing the least rapidly fatal results, it again appears that the degree of intoxication varies with the amount of toxins injected, but here again there was little evident connection between the assumed area of diffusion and the resulting absorption as shown by the intoxication. In general the horizontal was the position best tolerated (horizontal 196, head up 181, head down 137 minutes). The morphine and starved classes were again at the extremes. In both the fed and starved classes the horizontal position was the best borne; in the morphine class the head down was more favorable than the horizontal. It is pertinent to state that the only dogs which gave the least indication of surviving the injections were a morphine dog which received a maximum dose and a fed dog which received a mean dose. Both were in the head up group and both were chloroformed because it was feared that a large part of the injection had entered a bowel[1] where it is comparatively innocuous.

TABLE II.

Dogs showing greatest intoxication as measured by duration of life expressed in minutes. Coefficients express the size of dose in tenths of c.c.m. per kilo.

Groups	Fed	Starved	Morphine	Average
Up	72 [8]	40 [8]	88 [7]	67 4/9
Hor.	45 [8]	50 [7]	78 [8]	56 4/9
Down	40 [8]	44 [8]	95 [8]	60 [8]
Av.	53 [8]	45 4/9	85 4/9	61 1/9

The effects upon the rapidity of the heart's action, counted by stethoscope at ten-minute intervals, beginning 5-10 minutes after injection, are recorded in Charts 1, 2, and 3. These are taken from the records of single experiments which simulated most nearly the average results shown in Table 1 and are therefore supposed to be fairly typical examples. In the head up position there was a primary fall in the heart rate. The subsequent rise is supposed to measure the rate and degree of intoxication (absorption). The much prompter effect upon the starved dog is as striking as it was characteristic for this class of animals.

[1] It was noted when this mistake was made that the irritation of the mucosa by the venom soon induced audibly and palpably increased preistalsis.

In the horizontal position more rapid absorption is indicated. In the head down position the overwhelming effect upon the starved dog is well shown.

Summary. Excluding the starved dogs as a class, the foregoing evidence seems to point in a general way to a restriction of absorption by the limitation of diffusion. It may safely be assumed that under these conditions of extreme intoxication the prolongation of life was dependent more upon the preservation of a certain degree of blood pressure to continue the functional activity of the respiratory center (favored by the horizontal or head down positions) than it was upon slightly less rapid absorption of toxins to be expected in the head up position, which position was under these conditions too burdensome upon the heart.

Local Results. The effects of the action of the cobra venom upon the peritoneum must, through the nature of the experiments, differ greatly from the results obtained in the moccasin series. The intensity of the reactions varies with the amount of venom injected and with the duration of life. The one constant element is now in the ultimate lethal result.

The reaction to the cobra venom while actually more severe was less intensely hæmorrhagic than when moccasin venom was used. A still greater excess of free fluid containing free hæmoglobin was constantly found.

When the reaction was especially severe there resulted changes in subserous fat, an apparent disintegration, with the production of minute oil droplets. The omentum, mesentery, parietes, diaphragm, bladder, intestines, stomach, and fat were involved in about that order of frequency and severity.

When the muscular portion of the diaphragm was involved lesions were always present on the tendon, or the tendinous portion might be involved alone. If the intestinal involvement was extremely severe the most affected loops were purplish, suggesting an approaching gangrene. There was a less definite separation between the areas of primary and secondary diffusion (reaction) and the graphic records of these are consequently less accurate than in the moccasin series.

The extent of the local reaction has been charted from presumably average results, virtually the experiments from which Charts 1, 2, and 3 were constructed. The table on following page gives the data.

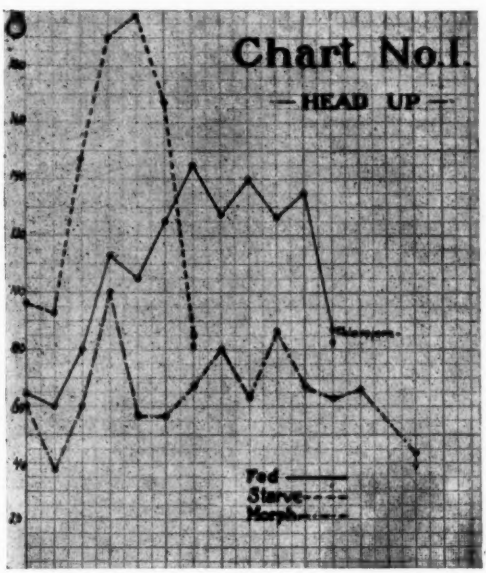
—TABLE III.—

Dogs showing least intoxication as measured by duration of life expressed in minutes. Coefficients express the size of dose in tenths of c.c.m. per kilo.

Groups	Fed	Starved	Morphine	Average
Up	140½	103½	*300 +	181′
Hor.	230½	167½	190½	196½
Down	122′	95½	195½	137½
Av.	164½	122½	288′	171½

* Chloroformed at 5 hours

There were no special peculiarities in the reactions, in all the excess fluid constantly bathed surfaces which showed no reaction. This fact, coupled with the regularity with which the most severe reaction was at and below the site of injection, whatever the position of the animal, leads to the supposition that the local reaction is primarily prompt, becoming progressively more attenuated. This is



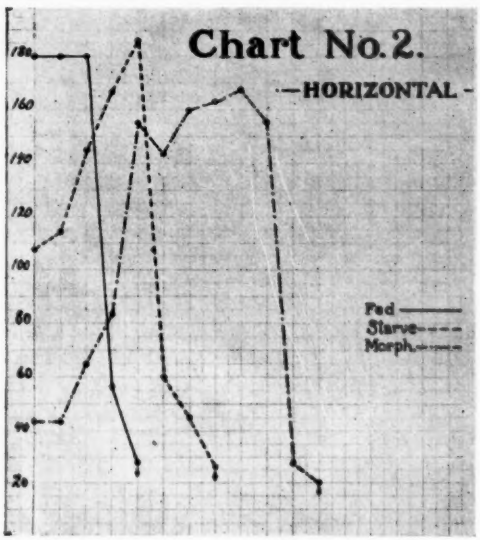
COBRA VENOM—LETHAL DOSES. DIAGRAMS VIII, IX, X

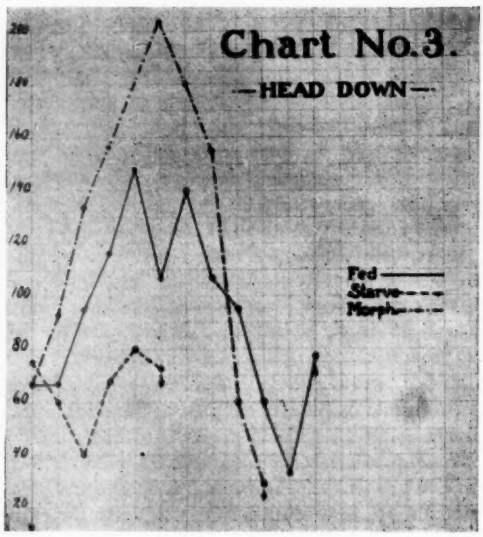
Group	Class	Limits of Areas of Diffusion			Remarks
		Primary	Secondary	Tertiary	
Head up.	Fed.	Lowest one-third of belly.	To greater curvature.	Via parietes to diaphragm muscle, via gastrohepatic omentum to diaphragm tendon.	Tertiary diffusion in 50 per cent of these experiments. Average length of life 114 minutes. Longest for this class.
Head up.	Starved.	Lowest one-third of belly.	To subgastric loop.	Via gastrohepatic omentum to tendon of diaphragm.	Tertiary diffusion in 50 per cent of these experiments. Average length of life 70 minutes.
Head up.	Morph.	Lowest one-third of belly.	Upon subgastric loop.	Via parietes to diaphragm muscle and gastrohepatic omentum to tendon of diaphragm.	Tertiary diffusion in 100 per cent. Average length of life 190 minutes. Longest for this class.
Horizontal.	Fed.	Lowest one-third of belly.	Upon stomach.	Via gastrohepatic omentum to diaphragm.	Tertiary diffusion in 100 per cent. Average length of life 96 minutes.
Horizontal.	Starved.	Lowest one-third of belly.	To greater curvature.	Via parietes and gastrohepatic omentum to diaphragm.	Tertiary diffusion in 100 per cent. Average length of life 88 minutes. Longest for this class.
Horizontal.	Morph.	Lowest one-third of belly.	To greater curvature.	None in this experiment.	Tertiary diffusion in 50 per cent. Average length of life 142 minutes. Shortest for this class.
Head down.	Fed.	Lowest one-third of belly.	Upon stomach.	Via gastrohepatic omentum to diaphragm.	Tertiary diffusion in 50 per cent. Average length of life 90 minutes. Shortest for this class.
Head down.	Starved.	Lowest one-third of belly.	Upon stomach.	Via gastrohepatic omentum to diaphragm.	Tertiary diffusion in 100 per cent. Average length of life 68 minutes. Shortest for this class.
Head down.	Morph.	Lowest one-third of belly.	To greater curvature.	Via parietes and gastrohepatic omentum to diaphragm.	Tertiary diffusion in 100 per cent. Average length of life 154 minutes.

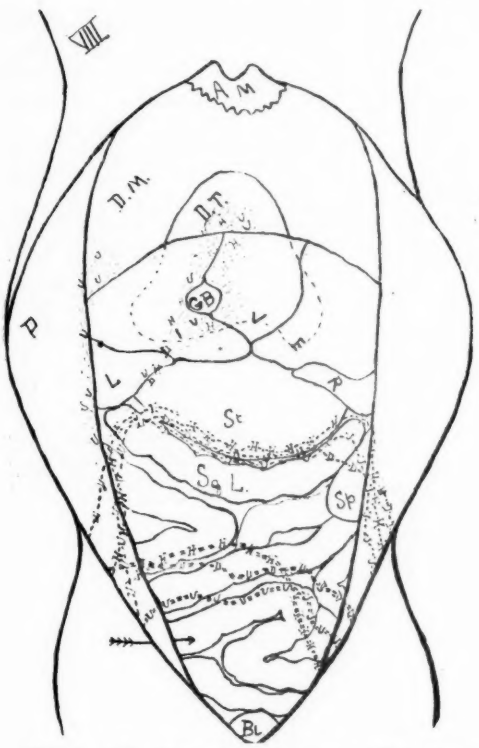
in keeping with the observations in the moccasin series. If this be true, then the rate of diffusion is quite as important as the extent of diffusion in determining the rapidity of the toxin absorption.

It is also noteworthy that the excess of free peritoneal fluid was never confined to any single portion of the abdomen but only increased in the most dependent part. In the head-up position the great excess was in and just above the pelvis. This was also true in the horizontal position, though with relatively more fluid in the flanks. In the head down position, though the great excess was high in the belly, there was relatively more in the pelvis than there was high up when the positions were reversed.

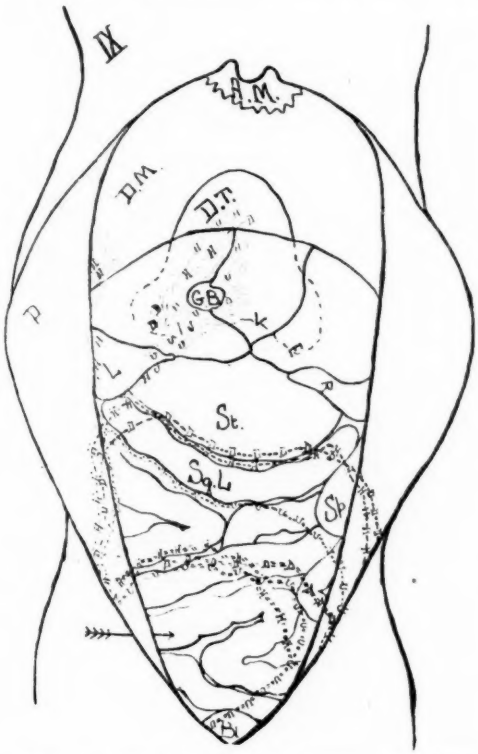
An examination of the severity of the re-







Diag. 8. Fed Dogs. Cobra venom, lethal doses. Areas of primary and secondary diffusion virtually the same for all positions.



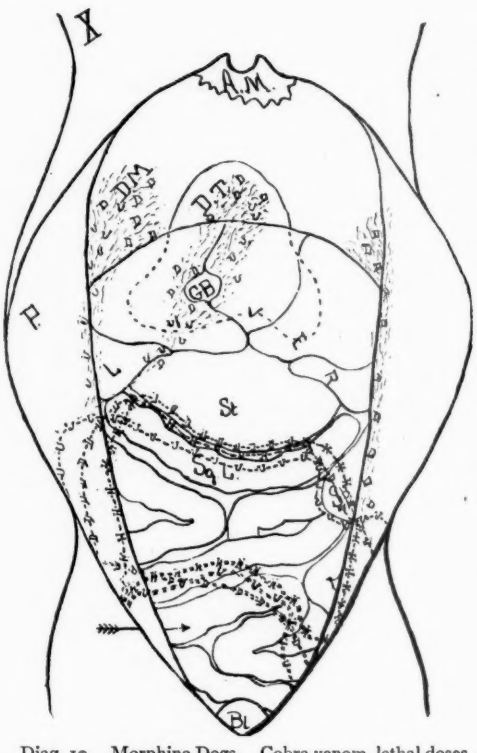
Diag. 9. Starved Dogs. Cobra venom, lethal doses. Areas of primary and secondary diffusion virtually same for all positions and similar to those in Diags. 8 and 10; Tertiary diffusion greater in extent than in Diag. 8.

actions relative to the classes of animals, fed, starved, and morphine, gave the following data:

Class	Character of Reaction			Amount of Excess Fluid			
	Mild	Moderate	Severe	Limited	Moderate	Considerable	Number of Experiments
Fed	0	5	8	2	5	6	13
Starved	3	5	4	3	7	2	12
Morphine	1	1	10	1	2	9	12

No satisfactory way to estimate peristalsis was discovered. The only comparable observations were made at the necropsies, which of course are inadequate but tend to indicate that the fed dogs had the most, the starved dogs considerably less, and the morphine dogs almost no post-mortem peristalsis.

Summary. The intensity of the local reaction depends, other conditions being equal, upon the length of time the toxin is in contact with reactable peritoneum; the length of life depends upon the rate of absorption of the toxin. The starved dogs, as a class, were the shortest lived and showed the least intensity of reaction *but not the least area of diffusion.* A comparison of Diagrams VIII, IX, and X shows that the areas of primary and secondary diffusion are virtually the same for not only all classes but all positions, and that the areas of tertiary diffusion are the variables which offer the possible explanations for the differences in the results.



Diag. 10. Morphine Dogs. Cobra venom, lethal doses. Areas of primary and secondary diffusion virtually the same as in Diags. 8 and 9. Tertiary diffusion is the greatest in the cobra series.

The starved dogs (average life 76 minutes) showed tertiary diffusion in 83⅓ per cent of the experiments, differing from the morphine animals (average life 162 minutes) only in the lesser extent and severity of these lesions. In the fed dogs (average life 100 minutes) the tertiary diffusion was present in but 50 per cent.

The logical conclusion seems to be that the starved dogs died the soonest because of a more prompt absorption (and a slightly decreased resistance), resulting to some extent from an early widespread diffusion, especially in the supragastric or tertiary zone. In consequence of the shortest duration of life they developed as a class the least intensity of reaction. On the other hand, the morphine dogs lived the longest because of slow absorption, and had time to develop the widest area of diffusion and the greatest intensity of reaction. The fed animals occupy an intermediate position in every respect but are closer to the starved class than to the morphine.

Simultaneously with the impression that the early wide diffusion is a very important element in the causation of the rapid fatality, comes the question as to the provocation of this diffusion. As far as was observed externally there was nothing to be held accountable. The morphine dogs, as a class, were quietest. Other conditions being alike, the internal factors promoting diffusion are (1) increase in fluid and (2) increase in peristalsis. Since the excess peritoneal fluid was least in the starved dogs, the evidence is almost conclusive that increased peristalsis resulting from the toxin stimulation of the starved (hyperirritable?) bowel is the causal agency in producing this early wide diffusion.

It is probable that this increased peristalsis not only favors increased absorption by widening the area of diffusion but also by increasing the blood and lymph circulation in the active viscera in contact with the toxin.

DISCUSSION

A satisfactory statement of the nature of the relationship between variations in diffusion and absorption must be based upon a rational conception of the ways in which absorption is effected. Consequently our conception of this process must be outlined.

Absorption from the peritoneal cavity differs essentially from somatic absorption in general only in rapidity, owing to the greater surface which participates actively (Klapp), and because a much greater blood and lymph supply is directly available. This process may be considered in two stages, (*a*) the primary passage through the serosa and (*b*) the subsequent entrance into the systemic circulation, either directly or by way of the lymphatics. The consideration of other problems is not germane to the subject.

(*a*) The passage of the peritoneal barrier results from (1) corpuscular activity (migrating phagocytes) and affects principally formed elements, pigment granules, animal and vegetable cells (MacCallum; Buxton and Tracy), though a path of little resistance is offered by

(2) resultant intercellular clefts or by (3) potential stomata and (4) areas denuded of serosa cells. However, the escape of solutions from the peritoneal cavity is much more extensively effected by osmosis (Starling) and by functional absorption through the serosa (Orlow), both of which methods are probably constantly operative (Clairmont and Haberer), though varying relatively with the character and concentration of the solutions.

(*b*) Having reached the subserous tissue, visceral or parietal, farther absorption is apparently more largely hæmatogenous; especially of simpler solutions, e. g., milk sugar, iodide of potassium, indigo-carmine, potassium ferrocyanide, strychnine (Starling; Mendel; Orlow; Klapp; Exner), as well as for certain constituents of the complex toxins, e. g., the hæmorrhagin principle in venoms. The lymphatics also participate in the absorption of such solutions, demonstrated by a slower absorption where this pathway is more or less excluded by ligating the right and thoracic ducts (Klapp) or by covering the diaphragm with collodion (Clairmont and Haberer). There is basis for the belief that the lymphatics may be relatively more important as paths of absorption under certain conditions (Meltzer) and when the substance is of high molecular weight, e. g., mercury (Meisel), or of complex molecular structure such as toxins (colloids). Presumably neither method acts to the exclusion of the other, though when the lymphatic is inhibited, the hæmatogenous may under some conditions carry on the entire work (milk sugar, Klapp; iodide of potassium, Exner). Lymphatic absorption is most active through the diaphragmatic channels and these are the principal, if not exclusive, portals of entry to the systemic circulation for formed elements (Buxton and Tracy).

The rate and extent of absorption from the peritoneal cavity under different conditions has been the subject of much experimental investigation. It has been found that all substances in solution are not taken up with the same rapidity, milk sugar is more rapidly absorbed than is potassium iodide, and when injected together one is absorbed independently of the other (Freytag). Aqueous solutions of crystaloids are more rapidly absorbed than colloidal solutions (Schnitzler and Ewald). It has been stated that absorption varies directly with the number of molecules in solution and inversely with the molecular weight (Achard, Gaillard, and Ribot.)

In general, acceleration of absorption has been observed to result from position favoring diaphragmatic absorption; active hyperæmia (Klapp); increased peristalsis (Klapp), even when the diaphragm was excluded (Clairmont and Haberer); mild and moderate degrees of acute peritonitis, chemical and bacterial (Freytag; Glimm; Clairmont and Haberer), and in certain types of advanced peritonitis affecting both the lymphatic and hæmatogenous absorption (Glimm).

The rate of absorption was not influenced by peritonitis resulting from the injection of sterile urine, stomach or intestinal contents; increasing the intraabdominal pressure by the injection of air; varying tonicity of the solutions (Clairmont and Haberer), or by the administration of physostigmine or atropine (Freytag, Clairmont and Haberer).

Absorption was delayed as the result of exclusion of the diaphragm (Clairmont and Haberer); ligation of the main lymph ducts (Klapp; Schnitzler and Ewald); passive hyperæmia (Freytag; Clairmont and Haberer) due to the slowing of the blood stream (Glimm) decreased peristalsis (Freytag; Schnitzler and Ewald; Clairmont and Haberer); particularly when obtained by opiates, opium itself being the most efficacious (Lennander); chemical and bacterial peritonitis (Schnitzler and Ewald); advanced acute peritonitis (Freytag; Peiser; Clairmont and Haberer); subacute peritonitis (Buxton and Tracy); chronic peritonitis (Wegner); chronic peritonitis with abscess formation (Freytag); previous injections of adrenalin (Peiser), but only for certain substances, e. g., potassium cyanide and strychnine, whereas potassium iodide was not affected; cold (Schnitzler and Ewald; Klapp) administration of chloroform (Orlow); laparotomy however short was effective, but but longer continued and the greater the drying of the peritoneal surface the more marked was the retardation (Clairmont and Haberer).

Comparatively little work has been done directly upon the problems involved in diffu-

sion and its relation to toxin absorption. Wegner likened the action of diaphragmatic breathing to that of a combined force and suction pump which he considered to be of great efficacy in aiding lymphatic absorption. This influence is unquestionable but acts indirectly through increasing diffusion (Meisel).

A series of very careful experiments bearing directly upon the question of diffusion was conducted by Meisel — small amounts (1.3 to 1 cc.) of very fine India ink were injected deep into the pelvis of rabbits, guinea-pigs, and kittens. Horizontal (ventral) and vertical (head up) positions were employed. Variations in peristalsis were obtained by digestion, and by intraperitoneal injections of castor and croton oils, physostigmine, "colitoxine," and opium. Physostigmine was also given subcutaneously. Respirations were varied by the vertical position and by dividing the phrenic nerves.

Many of his observations are extremely pertinent here. Capillary diffusion was noted to occur in dead animals when the possibility of post-mortem peristalsis could be excluded. During life, dissemination from the pelvic focus extended upwards in four fields: 1. Between the intestinal coils; 2. On the omentum and parietes; 3. Under the liver; and 4. Under the diaphragm. The size of the omentum has a decided effect upon the rate of spread of the pigment, an evident slowing when the organ is larger and symmetrically distributed, restricting particularly extension from the intestines to the liver. Indeed, the extension to the liver was principally along the parietal leaf (aspect) of the omentum (ventral position) and was influenced more by respiratory movements (rising during expiration and being fixed during inspiration), than by peristaltic activity, which was indirect in its effects. The action of gravity was less effective in the presence of active respiratory and peristaltic movements, and the *increased breathing of the vertical position may thus entirely overbalance these effects.* The paralysis of the diaphragm limits the dissemination toward it but not among the intestinal coils.

Colitoxin not only irritates the serosa but increases dissemination because of increased peritoneal fluid, rigid abdominal walls, *or increased peristalsis.*

Meisel's conclusions follow:

"1. The spreading of the material depends upon capillary space, although the presence of smaller quantities of air does not seem materially to influence dissemination.

"2. An invariable dependence of dissemination upon peristalsis is easily demonstrable.

"3. The influence of gravity is felt only when the moving forces decrease, especially with the cessation of diaphragmatic respiration.

"4. Irritating substances through increased peristalsis or through serous exudation apparently give assistance to dissemination. If the irritation produces paralysis of the intestinal coils, there results a greater accumulation of fluid in the most dependent part.

"5. The influence of respiration upon the particles in the pelvis disappears with complete paralysis of the intestines (distention with air); on the contrary, this influence persists in the presence of peristatsis even when restricted, as shown by division of the phrenics."

This discussion makes no pretension of being more than an incomplete review of recent literature, for the purpose of setting forth such apparently established facts as have some bearing upon this subject, and also as a substitute for any logical dissertation to justify the following conclusions based primarily upon the observations here recorded:

CONCLUSIONS

1. Intraperitoneal diffusion results from the operation of purely physical forces abetted by physiological activities.

2. The greatest attainable restriction of this diffusion must result from the opposition of controllable physical force to the paths of greatest extension and the inhibition of physiological activities.

3. Under similar conditions the rate of absorption varies directly with the extent of diffusion.

4. The restriction of diffusion and consequent absorption is best obtained by the action of generous doses of opium to reinforce the diminished activity in an empty alimentary canal, general bodily quiet with its resultant lessened respiration, and by the maintenance of that position of the body which will oppose

the action of gravity to the direction of most disadvantageous extension.

5. The absorption of toxins is dangerous in proportion to the rate and extent of that absorption, and, although this is complicated by pathological processes, it is limited by the application of the principles stated above.

CLINICAL SIGNIFICANCE

This consideration is limited to therapeutics of peritonitis as an adjunct to or substitute for surgical treatment. Though the conditions of the experiments are manifestly not directly comparable to human pathological processes, yet the results obtained emphasize clearly the importance of certain principles in modern practice.

The beneficial effects of *absolute* rest in the treatment of acute inflammatory processes in general are, if possible, even more apparent when this is applied to peritonitis, because not only immediate diffusion is restricted but the earliest formation of limiting adhesions is insured. Therefore, the greatest possible freedom from movements, active or passive, extrinsic or intrinsic, that can affect the abdominal parietes or viscera is the primary requisite.

This may easily be attained through the avoidance of everything that can stimulate peristasis,[1] by bodily quiet to decrease the force and rate of respirations and to relax parietal muscles (including the ilio-psoas), and by the absolute avoidance of forceful or repeated pelvic and abdominal palpation.

The administration of sufficient opium to guarantee the requisite freedom from movement is of almost equal importance, notwithstanding the more or less fancied dangers of masking symptoms or of inducing tympanites. Starvation probably does not immediately nor does it always completely control peristalsis; and, in addition, intestinal activity provoked by local toxic irritation merits consideration. The value of this means of controlling the diffusion causing the *early, which is the most dangerous*, absorption has not been sufficiently recognized.

Postural methods in the limitation of diffusion are of indisputable value but are of secondary importance compared to the maintenance of blood pressure sufficient to support life, and are frequently more extreme and continued longer than is necessary or even beneficial. Indeed, a lateral or dorsal horizontal position in many instances apparently gives better results.

External applications are of minor importance. The use of cold, when well borne, is amply justified, though moist heat is often more grateful and is of especial value in postoperative cases.

[1] This means the administration of *nothing* by mouth, by rectum only small enemata introduced slowly.

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CYSTITIS GLANDULARIS ET FOLLICULARIS[1]

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S. ALEXANDER describes the occurrence of lymphoid nodules or formations in the urinary bladder under the name of nodular cystitis.

Stoerck and Zuckerkandl recently, in describing their cases of cystitis glandularis, found besides the presence of glands, areas of lymphoid cells which presented a follicle-like arrangement.

The occurrence of both conditions, cystitis follicularis and cystitis glandularis, in the same bladder certainly presents a most interesting study in the histopathology of the urinary bladder.

Before describing the pathological picture in this case, it might be well briefly to review the various opinions which have been expressed from time to time as to just exactly what constitutes a normal bladder; as from the microscopic pictures before us, two questions naturally arise: Do glands normally occur in the urinary bladder, and is lymphoid tissue to be looked upon as a normal part of the bladder histologically?

There is no doubt about the fact that a big difference of opinion exists to-day in regard to this subject, which is easily proven by the many conflicting and contradictory statements found in both the literature and in the textbooks.

In regard to the presence of lymphoid tissue in the bladder normally, there are those authors who maintain that lymphoid tissue is not a normal constituent of the urinary bladder.

For example, Piersol in his book on Normal Histology says that simple lymphatic nodules or solitary follicles are found in almost all mucous membranes, those of the bladder and sexual organs excepted.

Stoerck says that he examined a large number of bladders in infants in large series and from various parts of the bladder for the presence of follicles, with the same negative results as were obtained by other authors.

According to Chiari, the mucous membrane of the bladder does not normally contain lymphoid tissue. That lymphoid tissue in the form of small masses occurs in the urinary tract he does not deny, but he says that their origin is in direct relation with the chronic catarrh of this mucous membrane.

Przewoski takes a similar view of this subject and says that, as they are absent at times in adults, they cannot be looked upon as a normal part of the bladder mucosa. He thinks they can develop at any period of life, and draws attention to the fact that they occur in a mucous membrane which shows all the signs of inflammation, and that the catarrhal conditions of the mucous membrane gives the best conditions for its development.

I wish to take this opportunity of briefly mentioning a case of cystitis follicularis which occurred in a 12 year old girl who died of diphtheria. The bladder mucosa, besides showing the presence of lymphoid cells, showed very marked changes of a severe cystitis, thereby corresponding with the statements of Przewoski and Chiari.

Taking a directly opposite view of the views expressed by the above-mentioned authors, there are those men who believe that lymphoid tissue is a normal part of the bladder.

Stöhr says that the tunica propria sometimes contains solitary nodules.

In describing the histology of the pelvis, ureter, and bladder, Böhm and Davidoff state that the mucosa often "contains diffuse lymphoid tissue wihch is more highly developed in the region of the renal pelvis."

Bailey is very positive, for he says that the stroma (of the bladder) consists of fine, loosely arranged connective tissue containing many lymphoid cells and sometimes small lymph nodules.

S. Alexander says that the presence of lymphoid tissue must be looked upon as the rule and its absence as the exception.

Weichselbaum found these formations in five individuals, varying from 20 to 23 years of age,

[1] Read at the joint meeting of the Chicago Surgical Society and the Chicago Gynecological Society, held in Chicago, April 17, 1908.

who never had had a gonorrhœa. He is of the opinion that normally lymph follicles may be present, but very sparingly, and that, not until they become swollen and enlarged by pathological changes, they become visible microscopically.

Ziegler holds a somewhat similar view, for he says that when the mucous membrane of the bladder contains small aggregations of lymphoid tissue, which are not uncommon about its neck, these are apt to protrude from the injected bladder surface as greyish white nodules.

Aschoff found numerous follicles in one newborn female.

But as our patient presents not only lymphoid tissue but also gland-like structures, a few words regarding them will not be out of place.

Aschoff says that it appears that not only are glandular formations absent in the newborn, but it also appears that any form of solid epithelial proliferations are absent in the connective tissue.

Riesman says there are no true glands in the ureter and in the bladder.

Böhm and Davidoff, as well as Charles Hill, Gray and Quain, all state that true glands are not found in the urinary bladder, although solid epithelial buds, which extend into the mucosa, have been described.

Zuckerkandl, on the other hand, found in a craniotomized child, spherical intraepithelial hollow spaces, surrounded by cells assuming a radiating position and containing a light droplet of a secretory product. In the bladder of a man, on whom death penalty had been carried out, he found gland-like epithelial structures. Zuckerkandl believes that physiologically this process is limited to a very small part of the bladder both as regards extent and intensity. Under pathological conditions this process can extend over the entire surface of the bladder.

Tourneaux and Herman found structures in the bladder of a 25 year old person, who was murdered, which they considered to be glands.

Rauber–Kopsch believe that the bladder contains both glands, which they call glandulæ vesicales, and lymphatic tissue, noduli lymphatici vesicales.

From the above briefly mentioned statements it at once becomes apparent that much confusion still exists in the histology of the bladder.

Attention should also perhaps be drawn to the fact that the tissue in this case was removed from the bladder during operation, from a patient who was suffering from severe bladder symptoms, "in contrast to those cases, in which the preparations were obtained postmortem and where we see nothing mentioned whatsoever of the clinical symptoms, their severity, course, and so on."

The patient, a male, 52 years old, entered the service of Dr. Louis E. Schmidt at the Alexian Brothers' Hospital, April 20, 1907.

Present trouble: About 15 months before the patient entered the hospital, he was seized with a frequent desire to urinate both during the day and night so that he would get up two or three times during the night. During the act of urination he had a burning sensation in the urethra. He also complains of severe pain in the perineum which continued up to 3 weeks before his admission to the hospital. He always urinates small amounts and always feels a "straining." As far as he is able to remember he has never passed any bloody urine. Occasionally, he would inject a weak solution of carbolic acid into his urethra. He has received internal treatment and treatment per rectum. He was catheterized "once."

Denies all venereal history.

Physical Examination: Head and neck negative. Eyes react to light and accommodation. Heart, lungs, and abdomen negative. The left kidney is palpable and slightly tender on deep pressure.

The rectal examination shows a rather "small" but otherwise negative prostate. Both seminal vesicles are palpable.

Urethra, negative.

After allowing the patient to urinate and then introducing a soft rubber catheter 90 c.c. of urine were obtained.

Cystoscopic examination (Dr. L E. Schmidt) shows no evidence of a generalized cystitis. The internal urethral orifice is œdematous. The trigone and the adjacent parts of the bladder are fluffy. Both ureters are slit-like and emitting clear urine.

Urine analysis: Reaction acid, color amber, sp. gr. 1010; albumen present. Sugar none. Sediment shows the presence of pus cells. No casts found.

Tuberculin injections for diagnostic purposes were negative.

A second cystoscopic examination was made by Dr. L. E. Schmidt on May 14, 1907. This examination was made several weeks after the first one, during which time the bladder had been treated. The result of the treatment can easily be seen by this, the second cystoscopic examination. The œdema present during the first examination was now absent. A very distinct and

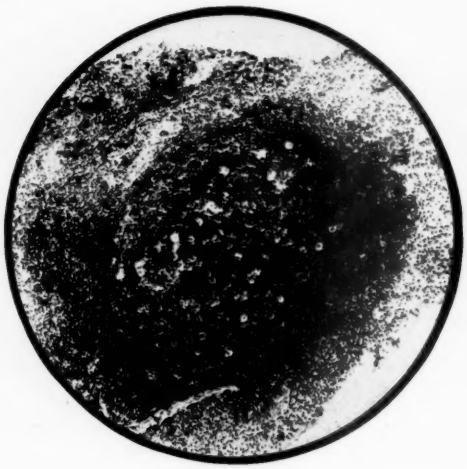

Fig. 1.

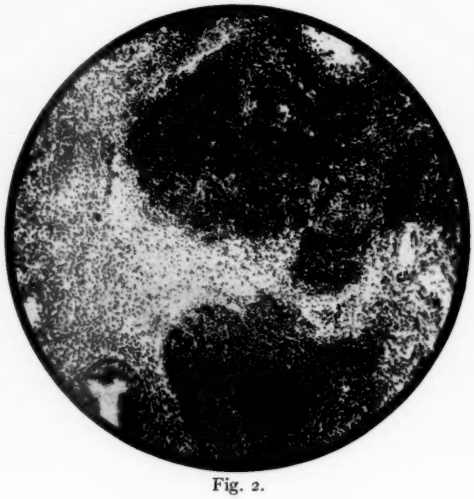

Fig. 2.

characteristic collar-shaped hypertrophy of the prostate was seen, the part at the base being well marked. The parts around the trigone appeared as though the bladder mucosa was thrown up in folds or rugæ. The vessels were very tortuous and engorged.

Repeated examinations of the urine for T. B. C. were negative.

Operation: Suprapubic cystotomy (Dr. Louis E. Schmidt). After opening the bladder a peculiar state of affairs presented itself. The ring of prostatic tissue was very *thin*, and was present or surrounded the internal urethral orifice completely. Especial attention was called during the operation, to the thinness of the prostatic tissue. The internal urethral orifice was dilated.

The trigone as well as those parts of the bladder adjoining presented a very peculiar condition. These parts were studded with small nodules, of a greyish yellow color varying in size from a pinhead to a caviar. They were more or less rounded in shape and of a rather firm consistency. Their resemblance to tubercles was noted, and attention was drawn to the fact that nowhere was there to be seen ulceration of the bladder, or a breaking down of the nodules. A few large nodules of an irregular outline and somewhat larger than the rest were seen. These were the result of fusing together of several smaller ones.

Several of the nodules were excised for microscopic examination. The rest of the nodules were curetted and the curetted areas cauterized with the Pacquelin cautery.

At the time of the operation, ureteral catheters were introduced into the ureters and specimens collected separately from each kidney.

URINE ANALYSIS

	Right.	Left.
Reaction	Acid.	Acid.
Phys. cond.	Slight turbidity.	Turbid.
Color	Yellow.	Bloody.
Albumin	Present.	Present large amnt.
Sugar	None.	Sugar none.
Sediment	Pus cells.	Leucocytes.
Bacteria	No. T. B. C.	Many red blood cells. No T. B. C.

Cystoscopic Examination (July 6, Dr. Schmidt): The bladder is much better, prostatic tissue is still seen completely around the internal urethral orifice. No ulcers present. Bladder mucosa has a bright yellow color and shows areas of injections. In the *bas-fond* may be seen quite a lot of adherent debris. Beginning trabeculization.

The microscopic examination of the two small pieces of tissue removed at the time of operation, show the presence of two distinct histological structures, namely the presence of lymphoid tissue and the presence of gland-like structures. This necessitates a detailed description of each and the lymphoid tissue will be taken up first.

Upon examining the masses of lymphoid cells, it is easy to see that the lymphoid tissue is present in two forms which stand out in marked contrast to each other.

In the one form we note the presence of small, more or less round cells, containing a round nucleus which stains very deeply with Hæmalum, and a small amount of cell protoplasm. These cells are very closely crowded together, which results in more or less distortion of the cells. These closely crowded cells form a layer consisting in thickness of about 6–8 cells, so that the cells on the inside of this layer and the cells on the outside stand out in marked contrast to one another. The cells inside of this layer are somewhat larger, contain a large nucleus, and the cells do not stain as intensely as the above-mentioned small cells (Fig. 1).

These lymphoid masses also show the presence of hollow spaces which may be very plainly seen with the

Fig. 3.

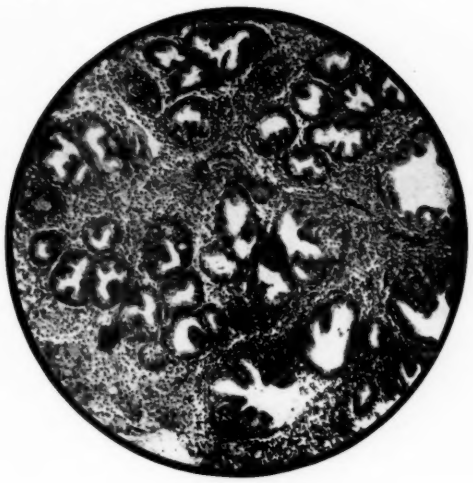

Fig. 4.

low power. Inside of these hollow spaces may be seen the presence of cells, about two times as large as the lymphoid cells, containing a large very faintly staining nucleus. Here and there may be seen in these spaces several polymorphonuclear leucocytes.

Standing in marked contrast to this picture we may see areas of lymphoid cells (Fig. 2) which do not show a dense compact layer of cells at the periphery, as were seen in Figure 1. In the center of these collections of lymphoid cells, no structural difference can be seen between the cells in the center and those cells at the periphery, either in regard to their shape or staining characteristics as was to be seen in the above-described follicles. Nor can we see the follicles studded with the above-described hollow spaces containing the large cells. These bodies can occasionally be seen and their occurrence is the exception in the picture rather than the rule, whereas in the first mentioned follicles they were an essential part of the picture. These follicles are more or less rounded in outline and they stand out in sharp contrast to the rest of the bladder tissue.

A distinct structural difference has been used for classifying cases of cystitis follicularis into the so-called true and false forms.

In the true cystitis follicularis, according to Zuckerkandl, the follicles are more or less rounded, the peripheral cells are closely crowded together so that they appear to be arranged in rows, and in which the cells in the center are richer in protoplasm and take a lighter stain (germinal centers).

The description of the changes noted in some areas corresponds with the description of a true cystitis follicularis, whereas other areas show the lesions of a pseudofollicular cystitis. In these no light cells (germinal centers) were noted in the center and no closely crowded cells were found at the periphery.

This leads one to ask the question, whether or not one is dealing with both cystitis follicularis and cystitis pseudofollicularis in the same bladder?

In a few places were noted islands of epithelial cells which were surrounded by a distinct connective tissue capsule, inside of which can be seen the large, more or less flattened, epithelial cells. In some of the islands may be seen a rather extensive invasion by polymorphonuclear leucocytes. Some of these islands show a most beautiful lumen formation. These islands bear a marked resemblance to the Limbeck-Brña-Brun Islands, but nowhere can cysts containing a colloid-like secretion be found. This picture brings up the possibility of some relation existing between cystitis cystica and cystitis glandularis.

The glandular formation is much more extensive than the lymphatic. Those sections stained with Van Giesen's stain, show the presence of a distinct connective tissue envelope containing flat connective tissue cells, which surround the glands (Fig. 3). In some places

Fig. 5.

Fig. 6.

the glands are seen as far down as the muscular coat, a part of which was included in one of the sections removed. In some areas a cross section of a single tubule can be seen, whereas other areas show the presence of a marked degree of branching, which always communicates with the central lumen. Some of the glands are lined with a single layer of columnar epithelial cells and in others it seems as though there were many layers of cells. The nucleus occupies a basal position and stains very deeply with hæmalum (Figs. 4 and 5).

In some of the cells the presence of a large, clear drop can be seen between the free border of the cell and the nucleus (Fig. 6). The droplet is of a variable size, so that in some cells it is of small size and has not changed the shape of the cells. In other areas the droplet is very large, so that the cell is very much distorted. Here and there it appears as though the droplet had caused the cell to rupture, so that the cell appears to communicate with the free lumen of the gland. In these areas their appearance is rather *suggestive* of goblet cells. In some places the entire cell seems to consist of this clear fluid and the picture reminds one of that of a mucoid degeneration. Polymorphonuclear leucocytes are seen inside the lumen of the glands as well as within the wall of the gland.

The vessels of the submucosa are everywhere filled with red blood cells. The submucosa shows very much round cell infiltration. The submucosa is œdematous.

The origin of the glandular structures occurring in this class of cases can at best be a mere matter of theoretical speculation. Some of the following possibilities may be mentioned:

1. We may take the stand that those men do who claim that glands normally occur in the urinary bladder, and then that in the presence of a severe cystitis a proliferation or multiplications of these few glands has taken place.

2. The presence of the masses of lymphoid tissue may be looked upon as having raised the mucosa in some areas, which must necessarily result in the production of pockets or niches elsewhere, that some of these become agglutinated and closed, with the result that a lumen is produced.

3. That these gland-like structures are produced by the cells of the bladder themselves. That the cells of the bladder possess some such property has been stated by several observers. In a recent publication Stoerck and Zuckerkandl come to the conclusion that the epithelium of the descending urinary tract, possesses the latent power of producing gland-like structures during postuterine life, which property is called forth by the presence of long-continued irritation. They mention three

cases of cystitis glandularis which occurred associated with stone in the bladder, and a fourth case in which xerosis of the bladder and ulcerations were present.

Herxheimer likewise attributes a peculiar proliferating power to the bladder epithelium, in regard to which he says: "The superficial epithelium and especially where 'epithelial nests' are found possesses a peculiar proliferative power physiologically so that the smallest amount of injury leads to a proliferation of the epithelial cells with the production of epithelial nests."

In regard to the lymphoid tissue we may say:

1. That *if* lymphoid tissue occurs normally in the bladder, it is found in very small amounts and is not found very frequently.

2. Large amounts of lymphoid tissue are to be looked upon as a part of some other co-existing lesion in the bladder. This may simply be a chronic cystitis, or it may be any one of the following lesions which were noted by S. Alexander who noted their occurrence in cystitis due to urethral infection, cystitis of stone, stricture, and prostates as well as in a case of tubercular cystitis.

I wish to take this opportunity to thank Dr. Louis E. Schmidt for his having placed this case and the clinical records at my disposal as well as for his interest taken in the work.

Since the reading of this paper, the patient presented himself at the hospital for examination. He has gained in weight, the urinary symptoms are much improved, he complains only of a slight burning in the urethra and cystoscopically the bladder was negative.

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ENORMOUS OVARIAN CYSTS

REPORT OF A CASE

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HAVING occasion recently to remove a large cystic ovarian tumor, a report of that case with some considerations of similar observations has not seemed to me to be out of place, in view of the large part of medical literature occupied by records of the more unusual and rare forms of disease.

The patient, a woman of fifty-four years, was admitted to the Methodist Hospital of Des Moines on September 4, 1907. She was referred to me by Dr. C. G. Dickey of Cambridge, Iowa. She stated that the growth for which she sought relief began when she was thirty-three years old, but had never caused any pain or special inconvenience except through its size and weight. Her discomfort from these conditions had been much worse since the birth of the last of her five children, thirteen years previously, or when she was forty-one years old. All her pregnancies had been normal, and she had never been seriously ill, though she had been confined to her bed several weeks by the abdominal pain and tenderness following a fall two years ago. For the last eleven months she was not able to walk, the growth is so large and the legs so swollen.

She presented, when admitted to the hospital, a greatly emaciated body appended to an enormously

Photograph of patient.

distended abdomen measuring at its greatest horizontal circumference 220 centimeters (seven feet, three inches) and obviously produced by fluid. She weighed 270 pounds in spite of her emaciated body. She was suffering at this time from considerable nausea, and occasional attacks of vomiting, and her legs were swollen and œdematous. The urine examination showed nothing out of the ordinary. During the first ten days in the hospital the abdomen was tapped three times, and the fluid withdrawn weighed altogether 150 pounds. It had a sp. gr. of 1018, varied but little in color, contained blood, fat droplets, cholesterin crystals and pseudo-mucin. After the last paracentesis the cyst was removed.

On opening the abdominal cavity a large amount of fluid and pseudo-mucinous gelatinous semi-fluid material escaped, and the peritoneum was found to be greatly thickened and adherent everywhere to one large cyst composed of four large compartments and numerous smaller ones all apparently arising from the left ovary. The omentum was practically obliterated and together with the intestines was crowded up under the diaphragm. It was necessary on account of the dense adhesions to dissect the cyst walls at many points from the parietal peritoneum piece-meal, and in this manner some cavities were opened which contained evidence of former hæmorrhage, the cyst contents varying from a thin chocolate-colored fluid to a thick meconium-like greenish black material. The abdomen was closed with drainage, and the patient made a good recovery although she died from a pneumonia developing one month later. It was impossible, in spite of repeated examinations, to ascertain any direct connection between the pneumonia and either the ovarian disease or the operation, and a post-mortem examination was refused.

Several comprehensive reviews of the literature dealing with large ovarian tumors have been made; those by Bullitt, Brunner, Idaszewski and Zacharias are perhaps the most notable. They naturally have had as their chief theme the operative treatment in its various aspects. Bullitt, however, in his summary of twenty-three examples of such growths all weighing over 100 pounds, has included several in which the conditions were ascertained by post-mortem examinations. Zacharias in his consideration of twenty-six cases has reviewed the operative procedures and tabulated the important facts in fourteen of them. Both these and other summaries have failed to include all the reports; in fact, there does not exist apparently a carefully made enumeration of all the reported monstrous ovarian cysts. The task, no doubt, of such a thorough review has not seemed warranted by the sole reason of their great size. Some hesitation might be experienced in establishing an arbitrary size and weight necessary to secure a place in such a collection; certainly great difficulty would be encountered in harmonizing the facts related bearing upon these characteristics, for there are many reports of growths so great as to entitle them to a place among the largest, where no accurate measurements or weights were taken or the records made are in other respects deficient.

In early medical literature before the extirpation of these enormous cysts was attempted, and the treatment consisted in removing a portion of their contents from time to time, there are accounts of their observation. Gould and Pyle, in their collection of "Anomalies and Curiosities of Medicine," mention several of these early reports, Zacharias and Idaszewski a number of others. To illustrate the character of these, that of John Hunter usually referred to as the Martineau case and presented to the Philosophical Society will serve. It concerned the removal of 3776 liters or 940 gallons of fluid from an ovarian cyst by tappings at intervals during twenty-eight years. The recent report (1904) by Shands of a similar treatment for an ovarian cyst in an aged woman is like an echo of the past in its resemblance to these earliest accounts; the cyst was tapped 130 times during seven years and nearly 500 gallons of fluid removed.

In a somewhat cursory examination of the literature I have found mention of five ovarian cysts weighing with their content over 200 pounds. The largest of these is reported by Spohn, and his estimate of its weight is 328 pounds, but it is not evident from his report how this estimate was made, and it may not be improper in view of the fact that this is considerably larger than others, to appear a little critical or to question the propriety of including in the total weight that of the fluid removed from time to time, for some period before its removal. It is to be regretted that more details are not given of this great cyst, for it is the only instance in the five mentioned growths exceeding 200 pounds, where according to the statements recovery followed extirpation. In 1879, Barlow observed at a post-mortem examination 72 pounds of fluid in a sac weighing 50 pounds from which there had been removed, on account of dyspnœa, 176 pounds of fluid in three days preceeding death, making altogether 298 pounds. Before the evacuation of the fluid was begun the patient's chin was in contact with the distended abdomen which rolled up over the thorax. In the third of these, operated on by Cartiledge and reported by Bullitt, the growth weighed 245 pounds; death occurred one week after the operation. In the fourth, Bullitt thought that death was caused by too rapidly emptying the cyst which weighed 225 pounds. The remaining one exceeding 200 pounds was removed by the elder Garcelon when he was 72 years old; it was followed by death two days after the operation, notwithstanding the withdrawal of most of the fluid five days prior to the operation. It may not be out of place to remark that all of these five examples of enormous cysts have been observed by Americans; only three are mentioned by Zacharias.

The cysts in the reports by Baldwin, Buffet, Dayot, Gilliam, Harris, and Smith, and that I removed, may be said to have had weights between 175 and 200 pounds. In two of these paitents death occurred; one in twenty-four and the other in forty-eight hours. Four others, including my own, recovered from the operation, and no attempt was made to remove the large growth considered in the report by Baldwin. Of seven cysts weighing with their contents between 150 and 175 pounds each, those reported by Maritan, Spohn (a second case), Squire, Cordier, Cullingworth, Davis and Brunner, there are two in which recovery is quite definitely stated, although Brunner's patient died three months after the operation from a general carcinosis. Squire's observations were post-mortem; the patient operated on by Davis died in six hours, Cordier's in half an hour, after the operation; the final result in the patient from whom Spohn removed an ovarian cyst weighing 166 pounds is not stated; in fact, this is merely an addendum to his record of the 328-pound growth. Ovarian cysts weighing between 100 and 150 pounds are much more frequently met with. Among nineteen within these limits as regards weight, recovery was the result in twelve out of thirteen operated upon, in three the final results were not evident from the accounts, and in three others their weight and size were ascertained post-mortem.

As already hinted at it has not seemed necessary in order to obtain a fair understanding of the facts concerning these excessively large cysts to attempt to consider all the available observations in medical literature. There are no doubt twenty reported cases which I have not considered, probably more. It is evident that the mortality following operation increases rapidly as the larger cysts are dealt with. Death has usually been ascribed to shock, but there do not as yet exist accounts of careful examinations post-mortem to determine the cause of death following the removal of these large growths. In twelve cases where puncture was followed by removal of the cyst there were seven recoveries; in ten removal of the unpunctured cyst was followed by recovery in six. Of the nine deaths in these twenty-two cases two were from infection, one from ileus, in five the cause of death was not stated, and in one the reason assigned was the too sudden emptying of the cyst (Zacharias). These large cysts are usually, as in my case, very adherent and especially to the paretal peritoneum of the anterior wall, less frequently to the viscera. Brunner found it necessary to resect a portion of the colon.

To any one who will carefully examine the literature pertaining to these large ovarian

cysts it will be evident that in spite of the frequency of operation for such conditions, opportunity is still afforded them to attain gigantic proportions. It will also appear of doubtful propriety to entitle contributions relating to ovarian cysts of 100 or 150 pounds by designations which may lead the casual reader to infer that the observations reported actually concerned examples of the largest growths of this kind ever encountered.

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ETIOLOGY OF ECTOPIC GESTATION[1]

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ALTHOUGH in the past several years there has been accumulating a considerable amount of literature on the subject of ectopic pregnancy, the major part of it has dealt chiefly with the clinical and the operative phases of this anomalous condition whereas the histopathological features, though of great importance, have been relegated to the background or have been entirely neglected. Thus it has come about that the therapeutic and operative treatment of ectopic pregnancy is pretty generally understood, and as this part of the subject does not fall within the scope of this paper, I shall do no more than allude to it.

There is a wide divergence of opinion amongst competent observers in regard to the abnormal changes in the Fallopian tube that are held responsible for the causation of tubal pregnancy. Some investigators attribute its occurrence to the existence of congenital[1] anatomical perversions in the structural formation of the tube, such as accessory ostia, persistence of the convoluted fœtal type of Fallopian tube, constrictions, flexions and other abnormalities. Others attribute it to lesions or changes that have resulted from an inflammatory process involving the pelvic organs, and more particularly the Fallopian tubes.

It is extremely difficult to arrive at the true cause of this not infrequent anomaly and at the best our ideas must be, to some degree, mere conjecture for the reason that, with a few exceptions, it is almost impossible to demonstrate just what lesion, congenital abnormal conformation, or pathological abnormality is presented by the tube at the exact site occupied by the ovum. The main difficulty lies in the fact that the pathologist is rarely able to make his observations until the condition has progressed so far that the original anatomical features have been obliterated or so altered that the recognition of the factor predisposing to the starting or development of the tubal pregnancy is obscured or rendered impossible.

Nevertheless, despite the existence of seemingly insuperable difficulties it is our duty to continue our researches in this almost unknown field, for not until we clearly understand the predisposing factor, or factors, which bring about an ectopic gestation, can we hope to institute a more intelligent preventive treatment that will result in a lessened morbidity or at least a lessened mortality.

The different observers, though they disagree in their views in regard to the remote causative factors of an ectopic pregnancy, are almost a unit in believing it to be due to some mechanical interference in the descent of the ovum through the tube lumen.

Only by pathological studies of these cases can we hope to arrive at a correct etiology but, as has been said before, the pathological reports are meagre or lacking so far as the histological features are concerned — the clinical and operative side being dealt with more fully. The clinical phases of the question, of course, are important and must be studied in conjunction with the histological changes. Clinical observation tends to confirm the view that an inflammation involving the pelvic structures has generally preceded the occurrence of an ectopic tubal pregnancy, though on this point, as one would expect, all are not agreed.

Reed says, to quote his own words, "The question arises, what cause or causes are responsible for an impregnated ovum remaining and becoming implanted in the tube, instead of passing into the uterus? Certain alleged causes formerly frequently cited as responsible for tubal pregnancy, such as inflammatory diseases of the uterus and tubes, must be absolutely discarded. We know that these conditions, instead of being the cause of tubal pregnancy, make a woman sterile for the time

[1] Since the completion of this paper, it has been my good fortune to operate upon a case of ectopic pregnancy, in which the very conditions that I have referred to principally from the histological point of view, were found (Figs. A, B, and C). See p. 520.

From the history of the case and of the attack incident to the extrusion of the ovum through the os fimbriæ (tubal abortion) a pre-operative diagnosis of ectopic pregnancy was made. The opposite tube was removed as a prophylactic measure; the pathological changes in it will be described in a subsequent paper. The patient made a good recovery.

[1]Read before the Clinical and Pathological Section of the Cleveland Academy of Medicine, March 6 1908.

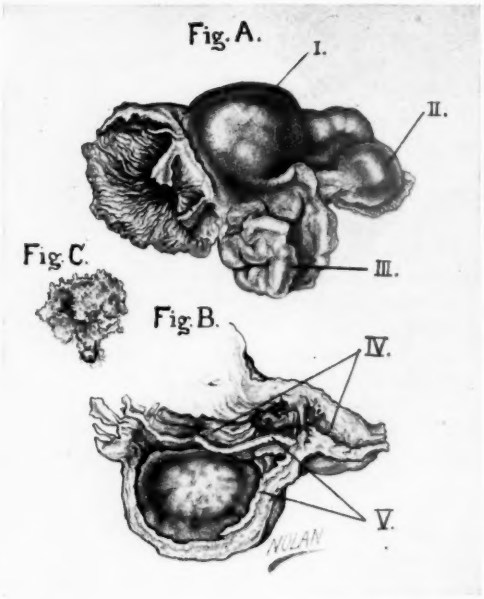

Fig. A shows a very large flared fimbriated tubal extremity with the longitudinal arrangement of the folds of the mucosa well marked. The hypertrophied tuft or tag of folds protruding at one point from the os fimbriæ represents the continuation of the folds (Fig. B, No. 5, upper line), that comprises the wall of the false diverticulum within. In the drawing in shape it suggests an accessory tube. The remaining border of the fimbriated end has somewhat ragged, thin edges, indicating in my opinion, the places at which they were adherent previous to the expulsion of the ovum, the tube being occluded except at the entrance to the false canal or diverticulum. It is often noted that a previously occluded tube opens first at an angle from which the mucosa appears to pout outward.

No. 1 shows a protuberance or a bulging of the wall of the tube on its anterior phase. This indicates the former site of the ovum enclosed in the hæmatoma.

No. 2 represents the cornual extremity of the tube with a nodular enlargement, a so-called "salpingitis nodosa." The condition is simply an irregular thickening of the wall due to the inflammatory infiltration and hyperplasia at this point.

No. 3 shows a fair-sized ovary with an irregular surface. It is intimately adherent to the mesosalpinx (which is infiltrated, thickened, and almost obscure) and to the tube. Except for adhesions the ovary macroscopically appears normal.

Fig. B shows the interior of the tube (No. 1) incised along its superior border — opposite its mesenteric attachment.

The irregular thickness of the tubal wall is noticeable, as well as the general increase in the size of the interior of the tube.

No. 4 indicates the course of the main central lumen of the tube which narrows as it approaches the cornual end but is patent throughout.

In the portion of the mucosa between the two lines (4) adhesions are seen extending from one side of the lumen to the other and between the individual irregular folds.

No. 5 shows very plainly the inner wall of an adjacent, parallel canal or diverticulum (false) to which I have referred throughout my paper. The funnel-shaped diverticulum is patent at the distal or fimbriated end but is occluded at its mesial extremity.

The cut edges of the hypertrophied mucosa forming the inner wall of the diverticulum are distinctly seen.

The upper line in No. 5 shows a continuation of the incised mucous fold (forming the wall of the diverticulum) with an intact hypertrophied fold which runs longitudinally to the extreme limit of the fimbriated extremity of the tube.

The hæmatoma, which measured 3.8 x 2.5 x 1.9 cm. in size, is shown in the figure occupying the dilated or pouched diverticulum (No. 5), from which however it has been previously extruded. On section this mass presented the developing ovum, at an early stage, imbedded in it. The site of the ovum in this case determined whether a rupture of the tubal wall or a tubal abortion was likely to occur. The latter came about.

Fig. C represents a piece of chorionic membrane with its chorionic villi well developed. It was found incorporated in a piece of blood clot removed at the time of the operation.

being and therefore exclude tubal as well as normal uterine pregnancy." I think you will agree with me that this conclusion is inaccurate and, as I shall demonstrate later, a tubal pregnancy is practically always preceded by an inflammatory reaction and in many cases by a period of sterility which, however, is only relative as the occurrence in nearly all of these cases of a delayed pregnancy would denote. Martin, who formerly held to the view that an inflammatory condition was responsible for the occurrence of an ectopic gestation now considers that it results from some mechanical interference with the descent of the ovum not necessarily, if ever, produced by an inflammation. On the other hand Dührssen considers tubal disease, particularly that due to a gonorrhœal infection, as the most frequent cause of extrauterine gestation. Schauta has advanced the theory that catarrhal, and especially gonorrhœal processes involving the tubal mucosa, predispose to the condition; and Küstner is of the same opinion.

When one studies these cases from a combined clinical and histological standpoint it is difficult to arrive at any other conclusion than that an inflammatory affection is responsible for the onset of an ectopic pregnancy and in fact the weight of opinion based on careful observation and study supports this view.

One might be inclined to believe that cases

of ectopic pregnancy were more frequent now than formerly, but this is not true. The apparent increase in the number of cases is due to better and surer methods of differential diagnosis and to the success of operative procedures carried out for the relief, cure, and sometimes for the diagnosis of the condition. Operations disclose many cases hitherto unsuspected.

The human organism alone, from data obtainable, suffers from ectopic gestation with all its sequences and complications. The lower animals are seldom, if ever, similarly afflicted. Bland Sutton[1] says: "I have made a careful study of the records and available specimens of extrauterine gestation in what are called the lower animals and quickly satisfied myself that tubal pregnancy in them is very rare; indeed, I have failed to find a single convincing record or specimen, but there are very many cases recorded in which puppies and kittens inclosed in tightly fitting sacs have been found adherent to the omentum and intestines."

His explanation is, that in mammals with two-horned uteri the horns are of the same length and often contain several fœtuses. When the fœtuses are too large to traverse the maternal passages, the uterus, as a consequence of its violent efforts to expel its contents, ruptures and the fœtus or fœtuses are extruded into the abdominal cavity. He found that although in many instances the animals die, in some cases they survive.

Reasoning from the results of his investigation of the subject we see that there must be distinct pathological changes in the human Fallopian tubes, that are seldom produced or found in those of the lower animals, to account for the occurrence and frequency of the condition in women. That an inflammatory condition alone might be capable of producing this wide variation between the lower animals and the human being is a proposition certainly worthy of consideration. We may ask why it is that the lower animals are so seldom if ever afflicted by this trouble. The only plausible explanation or answer must be that inflammatory affections of the adnexa are frequent in the women, while in the lower animals they are just as infrequent. Gonorrhœa is probably the chief predisposing cause, nevertheless all inflammatory affections, including those of tuberculous nature, play their part in producing conditions which favor an obstruction, and the consequent retention and development of the ovum within the Fallopian tube. An ectopic gestation in the ovary may be due purely to some simple obstruction to the extrusion of the ovum from the Graafian follicle wholly independent of any inflammatory process.

I had the good fortune some time ago to operate upon a case[2] of true ovarian pregnancy in which not only the ovaries but also the Fallopian tubes were macroscopically free from any inflammatory reaction. Histologically neither the tube nor the ovary removed showed any evidence of the existence of any inflammatory process. The right ovarian tumor with the Fallopian tube I removed, and saved the left tube and ovary. One year and eight months afterward the patient gave birth to a full-term child, having had a normal labor.

In this case, therefore, the ovarian pregnancy seems to have been due to the non-liberation of the ovum from its Graafian follicle, the spermatozoon having gained an entrance, and fertilization and development then having ensued, while the ovum remained *in situ*.

I need hardly refer to the anatomical structure of a normal Fallopian tube. The peritoneal coat lies externally, the mucous layer internally, while between the two are the two strata of muscle tissue, the longitudinally arranged layer without and the circularly placed layer within. This muscle tissue endows the tube with a peristaltic power which is available in the propulsion of the ovum along the mucous-lined canal. In the majority of inflammations of the tubes (which are practically always bilateral) marked changes ensue. The infection travels from within or from the mucosa outward through the muscular coats to the peritoneal surface, although before this has occurred infectious material may escape from the fimbriated extremity of the tube and involve the surrounding peritoneal surfaces of the adjacent or remote pelvic and abdominal viscera. We find the surface epithlium of the mucosa of the tube swollen, infiltrated, and in part degenerated and desquamated; here and there the cilia have been destroyed.

[1] London Lancet, Dec. 1904.

[2] To be reported later.

Very often in the acute and subacute processes a purulent exudate partially or completely fills and distends the lumen of the tube. This purulent exudate not only serves to harbor some of the invading bacterial organisms where they may later be annihilated by the leucocytes and by their own toxins, but would appear to serve another equally important purpose by keeping the mucous surfaces separated and preventing their coalescence which might result in a partial or complete destruction or obliteration of the tubal canal. In other words it apparently serves to maintain the patency of the lumen of the tube.

This fluid exudate may also serve another purpose. After the subsidence of the inflammation, and the destruction, disintegration, digestion, and absorption of its cellular elements, a so-called hydrosalpinx often results so that the lumen of the tube remains filled with a clear, pale, or generally yellowish fluid. As the fimbriated end by its freedom of movement, its increased size, and specific gravity, gravitates downward in the pelvis toward the cul-de-sac of Douglas, unless prevented by adhesions or otherwise, the fluid contents will tend to exert a constant pressure toward the occluded fimbriated extremity of the tube. This fluid pressure from within serves, I believe, to render the tube again patulous at the abdominal ostium, the patency being brought about more quickly in this than in any other way. The reopening of the distal end of the canal makes it possible for the tube to functionate again in transmitting the ovum. I have met with cases in which a small hydrosalpinx was present on one side and the opposite tube showed either a small opening at one angle of the almost totally occluded extremity or an almost completely restored ostium. At the narrow orifice the mucosa is usually found pouting and a histological examination of such a specimen would reveal the existence of a tube in which the fimbriated extremity had been occluded. The stroma of the mucosa together with the muscularis and the peritoneal coats of the tube shows varying degrees of infiltration and reaction according to the degree and the character of the inflammation present, although in most instances a certain amount of fibrous connective tissue is produced, as a result of the inflammatory reaction in the wall of the tube. Seldom does this tissue entirely supplant the entire muscularis even though much of the latter has been destroyed. Inasmuch as some of the muscularis can nearly always be demonstrated histologically, it is conceivable that peristaltic motion might still be possible although more or less impaired by the diminution in the number of muscle bundles and the increased amount of connective tissue. The mere adhesion of a tube to the surrounding tissue to some extent might interfere with peristaltic action, but could not wholly prevent it. Hence it is possible to have peristalsis of the tube after most inflammatory affections except when the tube is distended by a fluid or a semifluid exudate which temporarily impairs its functions, and puts it at rest so far as peristaltic action is concerned. We find in a salpingitis that almost always folds of the mucosa become adherent to those adjacent and at times to those projecting from the opposite side of the lumen. However, it is more usual to see them adhere in a parallel direction with the neighboring folds. When the lumen of the tube is distended by a fluid exudate, as is commonly the case, some of the smaller folds are partially or wholly obliterated by the resulting stretching of the wall. This also appears to be a conservative process to prevent coalescence of more mucous folds and thus an effort to further preserve the patency of the main lumen.

As the longitudinal folds of the mucosa in a salpingitis coalesce together in a parallel direction the epithelium enclosed by their cohesion is generally found in a well-preserved condition or, if it has been partially destroyed, it has been entirely regenerated owing to the protection afforded. The cilia are usually present — at least in part. By the cohesion of portions of the longitudinal folds of the mucosa and the consequent preservation of the enclosed epithelium which comprises the surface of the folds, epithelial-lined loculi and gland-like channels or canaliculi are formed. The former consist of spaces which may become distended with fluid to form cystic loculi. The latter or the canaliculi may be patent at one or both extremities, but more often are blind at the mesial and open at the distal end. The fluid

exudate in the tubal canal proper serves to keep open the end of the canal nearest the fimbriated extremity. These canals may be superficially placed in relation to the lumen of the tube, or they may occupy a position deep down beneath the surface epithelium or near the peritoneal layer. In the latter case there has been a hyperplasia of the connective tissue where the edges of the folds have adhered and thus the epithelial channels or loculi have been forced outward until they appear to occupy a position in the center of the thickness of the tubal wall or even farther outward. In a number of instances they are completely surrounded by a zone of connective tissue of varying thickness whose component cells are of more or less recent formation. The tendency is for the folds to adhere and give rise to the formation of these canals on the side of the tube opposite to the one towards which the fluid exudate gravitates when the exudate is insufficient in amount to distend the tube. In a similar manner the patency of the distal end of the canal — as opposed to the mesial or upper end — is maintained by the fluid which gravitates and exerts pressure toward the lower dependent or cœlomic end of the tube — preventing the tubal walls from coming together. These canal formations must not be classed with accessory tubal lumina, true instances of which are rarely met with. Most of those described in reality are not genuine but appear in sections of a much convoluted, persistent fœtal type of tube, the wall of the tube with its lumen having been incised twice in the same transverse or oblique plane so that there is brought into view what has been erroneously thought to be a second or branching lumen.

One occasionally finds the epithelial or ductlike remains of the Wolffian body coursing superficially along the wall of the tube, but these are generally situated nearer the external surface and are readily distinguished by the character of their structure.

To these epithelial-lined canals which are formed by the coalescence and cohesion of the folds of the tubal mucosa and by the inclusion of their epithelium I have given the name of false diverticula as opposed to the true diverticula of which I have had the opportunity of seeing only a few in the macroscopical and microscopical examination of many thousands of normal and pathological specimens. The presence of true diverticula seems to be one of the rarest of tubal malformations, whereas false diverticula are found in a large percentage of tubes as a result of inflammatory affections. There is no other structural (pathological or congenital) change in the Fallopian tubes so constantly present which could account for the occurrence of the anomaly known as ectopic or tubal pregnancy except possibly the partial absence of cilia or the infiltration and alteration of the tubal wall, by which peristalsis is impeded. But both are of themselves insufficient factors. My attention was first drawn to the formation of these false diverticula about six years ago, since which time much study and observation have only served to strengthen the conviction that in the greater percentage of cases of tubal ectopic pregnancy the explanation is to be found in this coexistence.

Recently Opitz [1] has drawn attention to the formation of these false channels or culs-de-sac formed by the adhesion of neighboring folds of the mucosa brought about by inflammatory affections within the tube. On making serial sections of the tubes in 23 cases of ectopic pregnancy he found that these canals or false passages were present in every instance. He looked upon them as lodging places for the ovum and held that their existence afforded a possible explanation for the occurrence of ectopic pregnancy. Landau and J. Whitridge Williams have referred to what may be called true diverticula found occasionally in the wall of the tube. The latter says "In connection with the normal anatomy of the tube I desire to call attention to an abnormality in its development which may bear a causal relation to the production of extrauterine pregnancy. I refer to diverticula extending from the lumen into the wall of the tube reaching almost to its peritoneal covering. They are lined by the typical single layer of ciliated epithelium and correspond in all respects to the structure of the normal lumen of the tube. They should not be confounded with the so-called accessory ostia of the tube; for, unlike them, they do not open on the outer surface of the tube and, on simple inspection, give no evidence of their ex-

[1] Zeit. für Geb. u Gyn. 1903. Bd. xlviii.

istence. I have observed this anomaly on two occasions."

He further states in reference to these diverticula "How often similar formations occur I am unable to state, for I have only found them twice and the only reference to them in the literature was made last year by Landau and Rheinstein who found a similar case."

Williams is inclined to think that a number of his cases of tubal pregnancy had so developed, but upon further examination he believed a more satisfactory explanation was that the fertilized ovum had burrowed beneath the mucosa "just as it does into the decidua in uterine pregnancy."

These structures branching off from the main lumen, I have noted in a number of cases. In two or three instances they were true diverticula but the greater number of them could be explained by a cross-sectioning of a convoluted fœtal type of tube twice in the same plane. The mucosa in the former is arranged in the form of folds similar to those seen in the main lumen of the tube. The mucosa of the false diverticula, however, is not arranged in the form of folds, the epithelial layer being very evenly and closely attached about the periphery.

Henrotin and Herzog have reported a case of ectopic pregnancy occurring in an accessory tube which had its origin from the side of the main Fallopian tube with the canal of which its lumen did not communicate. This case undoubtedly was due to the obstruction to the entrance of the ovum into the main lumen through the accessory ostium.

Webster holds that a "decidual reaction" occurring in an abnormal tube is responsible for the retention and growth of the fertilized ovum within it. This theory is plausible and on first thought might seem to carry some weight as an etiological explanation, but on closer analysis is untenable. I am inclined to believe that the ovum in a normal pregnancy when it reaches the interior of the uterine cornu, where the continuity of the tubal canal with the uterine cavity forms an inverted funnel, is blocked in its further descent into the uterine cavity by the hypertrophic changes which ensue in the corporeal endometrium preparatory to the reception of the fertilized ovum. The ovum then plays the part of a parasite, in its efforts to obtain nourishment and to live, by attaching itself to the mucosa which is later converted into a decidual membrane into which penetrate the chorionic villi. The growth of the ovum at this point very often causes a protuberance or a so-called gibbous condition of the uterine cornu which is often of value in the diagnosis of pregnancy. The author has had a number of cases of normal pregnancy in which this inequality of the two cornua could be readily made out on palpation at the 2nd to the 3rd month; the ovum afterward grows downward in the direction of least resistance.)

The reaction occurring within the tube is very slight as compared with that in the uterine mucosa and by itself would be quite incapable of completely blocking the ovum in its passage toward the uterine cavity. In tuberculous Fallopian tubes, in which ova have lodged and developed to form an extrauterine pregnancy, one would look for a very slight "decidual reaction" as a consequence of the limited vascularity and the destruction wrought by the tuberculous process. In most of our cases of tubal pregnancy the formation of a decidua, resembling the decidua vera of the uterine cavity, could be demonstrated but only at the site of the ovum and then over a very limited area.

In regard to Webster's explanation Kelly says: "Against Webster's theory, which Patellani and Moericke have endeavored to support, lies the insuperable objection that we know of no animal in which the uterine tube functions as a uterus." Bland-Sutton in the study of a number of specimens in the lower animals, in addition to the records in a number of cases, was unable to find one authentic case of extrauterine pregnancy. Schauta, Dührssen and others believe that inflammatory processes within the tube predispose to the development of an ectopic gestation.

Opitz has been able to demonstrate in a series of twenty-three cases the presence of diverticula from the main lumen, resulting from the union of the longitudinal folds of the tubal mucosa due to inflammatory affections. We have found these false diverticula or channels not only in every tube in which the ovum had rested but also in the tube on the opposite side. The inflammatory reaction in every case had been bilateral. Some of the tubes showed

evidences of a previous inflammation which had entirely healed, the anatomical changes alone remaining to indicate its pre-existence (cases of so-called "healed" salpingitis). Cases of ectopic gestation have been reported coexisting with a fibroma of the isthmus tubæ and again when polypi have been found in the lumen of the tube or at the cœlomic ostium.

External migration of the ovum which occurs not infrequently — the ovum passing from one side of the pelvis and entering the tube of the opposite side — has been advanced as one of the causative factors. It is believed that the ovum during the time consumed in its intrapelvic transit has gradually become so large that its propulsion along the entire length of the lumen of the Fallopian tube is impossible, and its progress is therefore arrested. External migration of the ovum has been observed many times, the corpus luteum being found in the ovary of the side opposite to that on which the ectopic was found. In fact Küstner noted the occurrence of external migration of the ovum seven times in a series of twenty-five cases, showing that it is not at all infrequent.

Where the ovary of one side and the tube of the opposite side have been extirpated not only true but ectopic pregnancy may result, external migration of the ovum being necessary.

While external migration serves to draw our attention to an absence of the tube or a pathological condition of the tube opposite to that in which the ovum finally rested, it proves only that a relatively greater impairment existed in the tube or that the tube was entirely absent on the side on which the ovum was liberated, or that the os fimbriæ of the tube on the opposite side was more accessible. Peters and others have proved that no chorionic villi are developed until the ovum has been nourished for a certain time by the decidua formed in the tube. In most instances the corpus luteum is found in the ovary on the same side as the tube lodging the ovum.

Hensen has shown conclusively that conception in women takes place in a manner similar to that in animals, the ovum in each case being fertilized in the ampullary portion of the tube, every pregnancy thus being primarily and temporarily at least an extrauterine pregnancy. He has also demonstrated that in dogs, rabbits, and guinea pigs the ovum remains several days in the Fallopian tube.

With the ovum normally retained for a number of days within the tube and with possibly an intrapelvic external migration, an impairment of peristaltic propulsion, a partial destruction or absence of the cilia, an ectopic pregnancy might result.

The corroding action of the ovum when implanted in the tissues of the Fallopian tube has been advanced as an etiological factor in the development of an ectopic pregnancy and even to account for the rupture through the wall of the tube. There is, however, very little evidence to substantiate this beautiful theory, as were this the case a similar corroding process would logically take place when the ovum is lodged in the uterine cavity. If it is possible for the ovum so to push itself through the wall of the Fallopian tube, why should it not corrode its way through the uterine wall? It appears to me that wherever the ovum is lodged and fertilized it is simply a question of obstruction to its descent and its external expulsion through the os uteri externum, whether the ovum remains lodged in its own Graafian follicle, in the Fallopian tube, or in the uterine cavity and here lays the foundation for an ovarian, tubal, or a normal uterine pregnancy. In most instances the ovum is simply impeded in its descent in the uterine cavity and remains confined in one or the other cornu owing to the hypertrophy of the mucosa with the decidual reaction that takes place coincident with the liberation and fertilization of the ovum. Its attachment and retention in the tube or in the cornu of the uterus is simply one of union of surfaces of living tissues, a parasitic invasion, so to speak, the fertilized ovum receiving its supply of nutriment from the new host and by the formation of chorionic villi and a decidua proceeding toward the development of the fœtus and its membranes.

The implantation of the ovum within the uterine cornu would explain the so-called gibbous condition of the uterus in normal pregnancies to which Dickenson and Howard Kelly have referred. Thus one cornu of the uterus, in the early stages of pregnancy, projects above that of the opposite side forming a more or less distinct tumor at this point. The protruding

cornu is generally softer in consistency than the other one.

Kelly says he has been able to verify this observation of Dickenson in many instances. I have also observed this inequality in size and consistency of the cornua in several cases of pregnancy but have not been able to elicit it after the third month. Kelly remarks that it is "as though the ovum had lodged and were developing in but one horn." I am inclined to believe that as a rule the fertilized ovum becomes imprisoned at this point, its further descent and escape being thereby rendered impossible for a time. When the ovum or embryo is implanted in one of the false diverticula in the tube, as described above, and especially in one which is rather superficially placed, it is easy to understand the early extrusion of the ovum through the wall of the tube and in the direction of least resistance or outward from the lumen of the tube. It is possible to have a very early rupture of the tubal wall in such cases without alarming symptoms or much injury to the tubal wall.

A tubal rupture and a tubal abortion seem to be dependent upon the site of implantation of the ovum along the Fallopian tube — the nearer the ovum approaches the uterine cornu the greater is the liability to rupture and the less the tendency to extrusion through the cœlomic ostium.

In all the specimens I have microscopically examined from the gynecological service of Lakeside Hospital, a bilateral inflammatory reaction has preceded the development of the ectopic gestation. The histopathological changes within the structure of the tube were too advanced to have occurred subsequently even where there had been a history (as happened in two of our cases) of a tubal rupture occurring one month previous to removal of the diseased structures. In every case, even in those in which a surrounding inflammation was very limited in extent, as evidenced by the presence of adhesions and by the general macroscopic appearance of the tubes, an existing inflammation or evidence of a pre-existent reaction could be demonstrated. In some there was a difference in degree in the extent of the inflammation, while in others a healed condition of the tube was to be seen. In no case had the inflammation been acute, but several showed a subacute or a so-called chronic process. Other tubes revealed an entirely healed condition of the tube, the anatomical changes that remained being the sole indications of the pre-existence of an inflammation.

Without exception, then, we found reliable evidences that an inflammation had accompanied or preceded the ectopic condition. Where both Fallopian tubes had been removed, the same appearances were noted in each excepting the changes in the one incident to the presence of the ovum and a slight difference in degree of the inflammatory reaction.

The tubes in every case showed subacute or chronic adhesions. The muscularis showed a diminution in the amount of muscle tissue, this having been sacrificed in part and replaced by connective tissue. In most of the cases, therefore, the tubal wall in the non-implicated, non-pregnant tube was noticeably thickened. However, in the tubes in which complete healing had occurred the tube wall, although it contained a diminished amount of muscle tissue with a relative increase of connective tissue, was not appreciably thickened. This fact, of course, is explained by the contraction of the connective tissue fibers which limits its vascularity, which regulates its formation. In the specimen showing an inflammatory reaction in the impregnated tube, or in the opposite tube when it was removed, the tubal wall was more or less infiltrated with small round cells, which always predominated, polynuclear, plasma, and eosinophilic cells were also present.

In only two cases was free pus present in the lumen of the tube and then only in very small quantity. Some of the ovaries removed, in addition to the external adhesions, including beneath them the germinal epithelium of the surface of the ovary, presented further evidences of an inflammatory reaction in their parenchyma. The tissue in some was very dense and somewhat altered in character from the normal type. At times, however, it was difficult to distinguish the newly-formed connective tissue in healed areas in a previously inflamed ovary from the original stroma. On this account it is possible to overlook many

cases in which an inflammation has at some time been present in the ovary.

In several cases a large recent or fairly recent cellular corpus luteum was demonstrable, but in others the corpus luteum had degenerated to form a cyst or the lutein cells had become replaced by fibrous tissue to form the so-called corpus fibrosum or corpus albicans (in the gross). Some of these were no doubt the results of a previous ovulation. Except in an occasional rare case in which the etiology is apparent, no one can say with certainty just what lesion, or combination of lesions, is responsible for the development of an ectopic pregnancy. It seems to me, however, that we must associate this condition with the most common lesion with which the tube is involved, as well as the opposite one, and one that is capable of obstructing and preventing the entrance of the ovum into the uterine cavity. Seldom does one find the cornual extremity of the tube occluded and thus is it possible for the spermatozoa to gain admission into the main lumen of the one or the other tube. If the uterine end of one tube were occluded and that end of the opposite one patent, the spermatozoa could enter the open one, advance along the length of the lumen and after an intrapelvic excursion, enter through the abdominal ostium of the opposite Fallopian tube to fertilize the ovum, whether its progress is blocked by its lodgment in a false diverticulum, by the simple occlusion of the uterine portion of the tube, by a polyp, or by the calcified remains of a fœtus, as occurred in a case operated upon by H. C. Coe and reported by J. W. Williams. This case showed an occlusion of the cornual end of the left tube which lodged two extrauterine pregnancies. It also demonstrated the external migration of the ovum (the corpus luteum being found in the right ovary) and also that the spermatozoa had entered the peritoneal cavity before reaching and fertilizing the ovum.

Actively motile spermatozoa have been seen spread out over the surface of an ovary and in the peritoneal cavity. The liberated ovum is seldom, if ever, inaccessible to the motile spermatozoa providing of course that the uterine end of the tubal canal is open and that their exit from the tube into the peritoneal cavity is possible whether that occurs through the normal abdominal ostium or through the lumen of an accessory Fallopian tube situated anywhere along its length. Thus an ovum, lodged in a diverticulum — which is simply an offshoot from the main lumen of the tube, generally branching off at an acute angle or running parallel with it — can be found and fertilized by the spermatozoa. We have demonstrated, as have also J. W. Williams and others, that cilia are always present in part and in addition that a portion of the bundles of the unstriped muscle tissue is always preserved. Peristaltic movements of the tube are thus possible.

Flexions are seldom so acute or marked that they would not straighten out under peristaltic action sufficiently to allow the ovum to pass. In flexions of the tubes examined histologically no perceptible atrophy of their wall nor stenosis of their lumen could be demonstrated at the site of the flexion.

Accessory Fallopian tubes are relatively rare. During my term of service as resident gynecologist we have had only 4 instances in a total of nearly 350 cases in which these existed. In no case of ectopic pregnancy were they demonstrable in either the pregnant tube or in the one on the opposite side.

Fibromyomata and polypi of the tube are exceedingly rare and we have failed to note a single instance of either. They are, we believe, of minimum etiological importance.

In external migration of the ovum there is no evidence to substantiate the assertion or the theory that delay in the entrance of or the augmented size of the fertilized ovum precludes its passage along the canal of the tube. The distance traversed by the ovum might be very short since the tube on one side has at times been found quite close to the ovary of the opposite side. Indeed it is probable that oftentimes in external migration, the opposite tubal ostium has been closer and more accessible to the liberated ovum than the tubal ostium of the same side. Other factors may influence the extratubal transpelvic route of the ovum.

After a review of the literature upon the etiology of ectopic gestation and a study of the pathological conditions associated with it both from a clinical and a histological standpoint we are led to conclude that the formation of false

diverticula, resulting from a salpingitis, is the most constant anatomical change or lesion found in the Fallopian tube capable of impeding the descent of the ovum and producing a tubal pregnancy. Personally I would venture the assertion that at least 95 to 98 per cent of these cases have their origin in this manner.

SUMMARY

1. A histological examination of the implicated (as well as the non-implicated) Fallopian tube in cases of ectopic gestation is of more value in explanation of the etiological factor or factors than simple clinical observation.

2. Clinical examination of the structures may reveal no evidence of an inflammatory reaction nor of anatomical malformations which, however, are possible of demonstration by microscopic examination.

3. Macroscopic examination may show no adhesions surrounding the Fallopian tubes, whereas, microscopically, the mucosa and muscularis of the same tubes may show the evidences of a pre-existent inflammatory reaction.

4. In all our specimens evidences of an inflammatory reaction, which had preceded the onset of the ectopic gestation, were demonstrable. The observations of Opitz in a series of 23 cases coincide with our own.

5. Schauta, Küstner, Dührssen and others believe that predisposition to a tubal pregnancy depends upon a previous inflammation in the tubes and that in most cases it is due to a gonorrhœal infection. With these conclusions I am certainly in accord.

6. An infection of the gonococcus of Neisser more than any other kind of infection predisposes to the formation of the false diverticula. A tuberculous process does not produce the ideal conditions for the retention and especially for the development of an ovum in the tube.

7. The inflammatory changes in all cases in which both tubes were removed were shown microscopically to be bilateral and diverticula were present not only in the tube which lodged the ovum but also in the opposite one.

8. The statistics of cases of tubal pregnancy occurring so frequently in the opposite Fallopian tube a few months to a year or more after an operation for the removal of one on the other side would warrant us in advising the patient that the retention of the apparently sound or slightly diseased tube may possibly lead to the development of another ectopic pregnancy.

9. Before saving of the opposite tube for the purposes of conception in the uterus, which I favor if the tube is not hopelessly occluded or too densely adherent, I should always warn the patient of the danger of another ectopic gestation. If the patient or her friends assume the responsibility, the tube, if capable of functioning, or if the occlusion or other pathological lesions can be corrected, should be conserved. Otherwise I advise its removal.

10. With the development of false diverticula or mucous-lined channels such as were histologically demonstrable in our series of cases and in that of Opitz the chances for an ectopic gestation as against a normal uterine pregnancy are in the proportion of from 2 to 8 to 1.

11. In a routine examination of many thousands of specimens I have noted the presence of true anatomical diverticula in a few instances. The other possible factors ascribed as etiological factors are many times rarer than the cases of ectopic pregnancy.

12. From an exhaustive study of the subject and from the analysis of a series of cases we believe that the presence of these false mucous-lined channels or diverticula produced by an inflammatory reaction in the tubes is the chief predisposing cause of tubal pregnancy in at least 95 to 98 per cent of all cases.

ON GANGRENE OF THE VERMIFORM APPENDIX

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On November 8, 1907, Dr. Hewetson, of Reigate, asked me to see a lady with the following history, for the details of which and of the successful after treatment I am indebted to him. Her age was 41 years, she was of rheumatic habit, and she had suffered from constipation and indigestion for several years and from occasional attacks of eczema which were also of recent date. Otherwise her previous health was unimportant. There had never been any serious abdominal illness or any symptoms that were attributed to appendix mischief.

On November 4th, a widespread, acute eczema developed with much itching, affecting chiefly the left arm and the left hip and thigh. There were no gastric or intestinal symptoms whatever and the temperature and pulse did not rise. The patient was kept in bed, soothing treatment and a mild laxative being prescribed. No other symptoms developed until November 6th, when there was a slight pain with tenderness far back in the right loin. The pain did not become serious and no lump was felt at any time. The pulse-rate and temperature rose very gradually, and they were not above 100 to the minute and 100° F., respectively, on November 7th, the fourth day of the illness. The bowels did not act after November 5th and no aperient was given after November 4th.

On the morning of November 8th the patient's condition, which had caused little anxiety until then, was obviously very serious. She vomited and there was severe pain with resistance to examination in the right loin, the whole abdomen being slightly distended. The pulse-rate was 120, and the temperature was 102° F. When I saw the patient in the early afternoon, she was so tender all over the abdomen that examination yielded no further information and I fully agreed with the decision already arrived at that the abdomen should be opened.

Everything being in readiness, Dr. C. H. J. Watson anæsthetized the patient and in the presence of Dr. Herbert Stone and Mr. P. C. Prince, with the assistance of Dr. Hewetson, I cut down upon the most common position of the appendix by a short incision made rather higher than usual. There was no general peritonitis, but some adhesions were discovered in the loin where the pain was first felt, and, as the appendix was not found elsewhere, the incision was extended towards these adhesions. They were too firm to have been of very recent formation and when they were partially broken down there was an escape of serous fluid which was quickly mopped up, but which it was not possible to keep from being spilled to some extent over the surface of the wound in the abdominal wall.

The appendix, as described below, lay amongst the adhesions and was brought out of the abdomen, its greater part being obviously dead. Its proximal end which had not sloughed was so soft and friable that I was not able to remove it by the sleeve-cuff method. It was therefore simply tied by a ligature round the base and the parts beyond were cut away. The portion of the cæcum adjacent to the appendix had also a very sloughy appearance. When set free, these unhealthy parts lay deeply in the right loin and I made a second posterior incision directly upon them, through which two large rubber tubes with gauze wicks were introduced into the peritoneal cavity, and loose gauze was packed round the appendix stump. The anterior wound was closed in the usual way.

During the first night after the operation the patient's chief complaint was of itching due to the eczema, but this did not continue. There was some vomiting which ceased after about twelve hours and there was not much pain. The bowels moved on the second day and each day afterwards without any difficulty. The temperature in the evenings gradually fell until on the third day it was 99.2° F. The morning temperatures were subnormal up to that time and the patient was weak and feeble. From the third to the sixth days there was a gradual rise of temperature to 100.6° F., to which point it rose every evening for four days and then it gradually fell to normal. After the fourth day the morning temperatures followed those of the evenings fairly closely. The pulse-rate was not above one hundred to the minute after the day following the operation. Dr. Hewetson removed the drainage tubes when they had been in position twenty-four hours, and he repacked the posterior wound with gauze. The discharge from it was very offensive and it looked unhealthy and sloughy in its deeper parts so that it had to be dressed daily. There was no sign of a diffuse peritonitis at any time.

On the sixth day there was an escape of gas followed by fæces from the posterior wound. A considerable area of the unhealthy cæcal wall around the stump of the appendix must have given way and a large amount of fæces was discharged for about three weeks. At that time the bowel conditions were very uncomfortable, both laxatives and enemata increasing the flow from the loin. Later the escape gradually ceased and the wound almost closed, but five months after the operation there was still a minute opening discharging about three drops of pus in twenty-four hours.

The anterior wound appeared to heal well, until the sixth day when it was tense and looked as if it might break down. Next morning there was an escape of a small quantity of pus and on the tenth day a slough about two inches long was discharged. After its extrusion union was rapid and the scar is now firm and strong.

In other respects the patient has made an excellent recovery, the condition of the bowels and of the digestion being better than for some years before the operation. There is still occasionally a little trouble from eczema.

The part removed, as regards about three-quarters of an inch of its proximal end, was slightly thickened, soft, and easily torn, but otherwise normal in appearance. The rest of the specimen consisted of the sloughed mucous membrane, unopened, absolutely flaccid, and of a dark blue-black color with a thin cap-like covering of red, vascular, unsloughed tissue over about half an inch of its tip. Apparently, three-fourths or more of the mucous membrane had died and separated from the muscular coats, which must have become adherent to adjacent peritoneal surfaces during some previous unnoticed or forgotten inflammation. Between the dead and the living structures there had exuded a highly septic serous fluid.

There can be no doubt that the sloughing, after the operation, of a piece of tissue in the abdominal wall was caused by the action of microorganisms or of the products of microorganisms in this fluid, and it is fairly certain that the previous death of the mucous membrane of the appendix was caused, or, at least determined, by the presence of the same breed of microbes.

But it is clear that the death of tissue both in the abdominal wall and in the appendix was clinically and, I think, pathologically different from that which occurs, for example, in the core of a carbuncle. In the latter the dead tissue is surrounded by a wide area of serous exudation and round-cell infiltration, whilst the part that dies is itself greatly hypertrophied by inflammatory action before it becomes a slough. On the other hand, in the case recorded above, the dead portion of the appendix retained very much of the size and shape of the normal structure and was well defined in its outline, as if the area of the action of the organisms was strictly limited and was not preceded by inflammatory thickening. The necrosed portion of the abdominal wall also would seem to have been sharply localized from the first, and as soon as it separated, the wound rapidly healed.

A circumscribed death of tissue may be due to various causes or combinations of causes. It is obvious that a sufficient crushing, burning, freezing, or chemical action will kill the affected parts. We also know that a deficient blood-supply causes death of tissue, and Sir Benjamin Brodie pointed out that after an injury to the spinal cord gangrene of parts of the lower extremities might occur within twenty-four hours, a change in the nervous supply of the tissues being suggested as the probable cause of this rapid development.

Whenever a local death occurs in parts exposed on an external or internal surface, microorganisms act upon the dead tissue sooner or later, and the condition is frequently accompanied by pain and febrile symptoms. But when animal structures are deprived of their proper blood-supply, they may be profoundly altered in their physiological characters without becoming putrid or painful. In the brain and in the retina the blocking of a blood-vessel may lead to such a change of structure that the loss of function is complete and permanent; and in the case of the retina there is frequently no symptom except blindness which, being unilateral, is sometimes not immediately discovered. A collateral circulation is developed and the parts do not die, yet there can be no reasonable doubt that, if the areas of tissue supplied by the blocked arteries were on a surface of the body, they would in almost every case, if not invariably, become infected by microorganisms and be cast off as sloughs.

Again in necrobiosis of a fibromyoma of the uterus the tissues become necrotic without becoming septic. In such circumstances the necrotic tumours retain much of their normal shape and appearance and it has been shown that they are sterile,[1] although by a microscopic examination it is seen that they have lost all signs of a cellular structure.

As regards symptoms, a development of this particular example of necrosis may be accompanied by intense pain and by well-marked febrile reaction, but on the other hand there may be no symptoms at all, fibroid tumours haying been frequently found in a state of necrosis when there was no clinical indication of the existence of any abnormality in them.

In cases of senile gangrene, also, there may for a time be no pain. Sir Benjamin Brodie wrote that "with regard to this symptom, both in the early stage of the disease and afterwards,

[1] John S. Fairbairn. The Journal of Obstetrics and Gynecology of the British Empire, August 1903, p. 133.

there is a great variety, such as it is not very easy to explain." Percival Pott said of senile gangrene that "in some few instances it makes its appearance with little or no pain"; and Professor James Miller, of Edinburgh, stated that "we may have senile gangrene throughout unattended with pain, redness, swelling, or other sign of the inflammatory process; excepting ultimately at the line of successful separation."

Thus a mere local death of tissue, even on an exposed surface, does not necessarily cause pain or other symptoms, although when the death of tissue is combined, as it frequently is, with inflammatory manifestations, the pain is often intense.

It follows that in some cases of senile gangrene, if the parts were not open to inspection, their condition for a time could not possibly be known from any symptoms. I have ventured to suggest elsewhere that a similar symptomless death of tissue may occur in the vermiform appendix and that this should not be regarded as a product of inflammation or of any condition directly causing an inflammation. By this hypothesis the case recorded above is easily understood and by it many cases and conditions which are otherwise obscure may be satisfactorily explained.

It is almost certain that in senile gangrene and in necrobiosis of uterine fibromyomata, the cause of death is primarily a deficient blood-supply to the parts, and without doubt this is the cause of blindness from blocking of the retinal artery. But it does not necessarily follow that when gangrene occurs without symptoms it must be due to a deficient blood-supply. It may be so, or some nervous influence may be at work, but it is also possible that slightly damaged tissues may be killed by microorganisms without pain or constitutional symptoms arising. Perhaps there are microorganisms which can affect even normal tissues just as it would appear that diphtheria, smallpox, cholera, plague, and typhoid fever may possibly develop in healthy individuals. There is, however, no evidence that septic microbes can make an impression on normal epithelium. So far as we know they act only upon tissues the vitality of which is lowered by disease or injury. Of course, there are many that have definite effects upon healthy structures, if only some injury gives them access to those structures; and when a breach of surface, however slight, occurs in unimportant parts any untoward results that follow depend chiefly upon the nature of the organisms admitted. The effects vary much, and, for example, those of the bacillus anthracis, a streptococcus and a staphylococcus may be mentioned. The particular development shown in the case under consideration was a localized death of tissue and it was obvious that the necrosis, especially that in the abdominal wall after the operation, was caused by a microorganism or by the products of a microorganism, whilst there was nothing unusual in the temperature or pulse to indicate that any important effect was being produced. There was certainly no evidence of a greater febrile reaction after the operation than the surgical procedures and the septicity of the parts would account for. Indeed, the temperature at first rather indicated that there was a tendency to collapse. The sloughing of the mucous membrane of the appendix was also associated with symptoms which for nearly four days did not show that there was any serious condition.

In another case[1] I opened and drained by means of rubber tubes a putrid appendix abscess deeply situated behind the cæcum, and the patient appeared to make good progress in every way, except that the discharge remained putrid. The temperature gradually fell from 101.6° F. to 100.4° F. three days later. In the early morning of the third day after the operation the patient, who had been sleeping quietly for between two and three hours, awoke and found something trickling from the dressings which, on inspection, were found to be soaked in blood. The hæmorrhage was accompanied by a fall of one degree of temperature to 99.4° F. and was followed by a rise to 101.4° F. The bleeding stopped and again for a time all seemed well, except that the discharge was still putrid and the part of the wound that had been sutured tended to break down, blood having been forced between its surfaces. The temperature fell gradually until the sixth day, when there was another bleeding without

[1]This and other cases referred to are already more fully published elsewhere, chiefly in the Clinical Society's Transactions, 1906, and in the Medical and Chirurgical Society's Transactions, 1906.

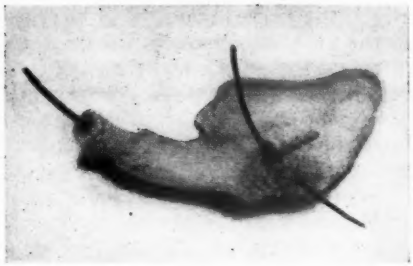
any warning, and sufficiently copious to make the patient become unconscious. On opening up the wound no bleeding vessel was found. As the abscess cavity was behind and rather to the inner side of the cæcum, it was impossible to inspect the deeper surfaces from which the blood appeared to have come without disturbing the parts to an extent which seemed unjustifiable, but on the exposed, more superficial raw tissues there were several well-defined sloughs about a third of an inch long and not deep. They looked exactly like dark coloured colonies of some organism growing on a suitable medium in a culture experiment. An unsuccessful attempt to find the appendix was made and it was noted that, although the discharge was putrid, the coagulation of the blood was so firm that more than once I thought I had got hold of the appendix when I only felt a piece of clot. The entrance to the deeper part of the wound was made very wide, the cavity was packed lightly with gauze, and the patient recovered without further hæmorrhage. The discharge ceased to be offensive on the third day and the visible sloughs were all separated after five days. It seems certain that a colony of slough-inducing organisms had eaten into some vessel in the deeper part of the wound without inducing any symptoms, except of course the hæmorrhage, that differed from those usually seen when a putrid abscess is opened and heals well.

In recording this case I quoted from the Lancet a similar one which shows how much more serious the results of the bleeding might have been. In that case a putrid appendix abscess was opened and ten days later, when toxic symptoms had almost ceased, the patient felt his side wet, his dressings were found to be saturated with blood and he "rapidly succumbed." I quoted another case, also from the Lancet, of a boy, aged ten years, who suffered from hæmorrhages on the 9th and 11th days after an appendix abscess was opened, and it was found necessary to tie the external iliac artery in two places because of an opening in its wall an inch and a quarter in length. The patient recovered. An almost exactly similar case was described in the debate on my paper at the Clinical Society, of London, by Mr. Raymond Johnson who also successfully tied an external iliac artery on account of hæmorrhage after an appendix abscess had been opened by another surgeon. In none of these cases did it appear that there was any indication of unusual mischief before the bleeding took place. This form of secondary hæmorrhage is not confined to appendix cases. I know of three recent instances in the practice of three different operators and in three separate institutions in which hæmorrhages occurred from other parts of the body after operations on septic tissues, and there was the same condition in all, namely, that the patients were apparently doing well in every way when the bleeding took place.

The case of hæmorrhage which I have quoted from my own work and the case related at the beginning of this paper seem to indicate that the organisms which induce a localised death are more effective for mischief when the tissues, or the microbes, are under pressure, but probably their action is facilitated by other causes of lowered vitality, such as a previous or existing catarrhal inflammation, the irritation of a foreign body, the blocking of an artery, or an interference with the nervous supply of the parts.

Whenever flesh wounds are made in healthy structures by a surgeon, complications caused by microorganisms may, of course, be absolutely prevented by attention to the principles taught by Lister and since developed into those of modern aseptic treatment, but in some diseases of the appendix, and in other cases which are septic before the surgeon is consulted, it would appear that even now we cannot avoid occasionally coming face to face with complications characteristic of pre-antiseptic days and for which the only surgical treatment is by securing the most free drainage that is possible.

Rare anærobic organisms, difficult to isolate, have been described as causing gangrene and there can be no doubt that an organism exists, or it may be there are many, with the power, perhaps only under particular circumstances, of killing tissues locally. Such organisms are a frequent cause of trouble in the vermiform appendix and one of their most important characteristics is that they, or at least some of them, may cause gangrene which is not accompanied by any symptoms except those that follow the death of tissue.



Appendix removed when the patient was apparently well. The gaps in its wall are much reduced in size and granulative tissue. They were closed in by lightly adherent intestine. (Taken from the *Lancet*, July 28, 1906).

One of the most conspicuous instances of gangrene formation, apparently preceding symptoms, that I have seen was that of a lady, aged 71, who complained of a slight pain in her right side. It was so trivial that her doctor could only with difficulty persuade her to go to bed and be examined. He asked me to see her thirty hours after the onset of pain, more because I was seeing another case with him than because he was particularly anxious about the patient. There was tenderness and some resistance in the right loin well above the usual position of the vermiform appendix. The temperature had gradually risen to 100° F., and the pulse-rate was between 80 and 90 to the minute. The bowels had not been opened for two days, which was not an unusual time, and the rectum was full of fæces which were cleared out by enema. Vomiting set in during the night, and next morning the patient was very feeble, the pulse-rate was 120 to 130 to the minute and the abdomen was distended, tender, and resistant. The temperature had only risen to 100.6 ° F. Laparotomy was performed forty-four hours after the pain began and the appendix was found surrounded by flaky lymph and two or three ounces of serous fluid unlimited by adhesions. There were three well-defined necrotic patches in the wall of the appendix. The largest was about three-eighths of an inch in diameter and none of them showed any tendency to separate or any evidence to the naked eye of irritation at the line of demarcation. In this case it is certain that the gangrene of tissue was not due to an organism causing a severe inflammatory reaction or to one that induced pus formation. It would appear rather that the death of tissue took place without symptoms and that the slight pain, the slight fever, the lymph formation, the serous exudation, and the bowel conditions were due to irritation of the peritoneum by an organism of a common type, probably a staphylococcus, which passed through the dead patches of tissue. According to this view, the gangrene either was not caused by an organism, or it was due to one having a strictly localized but powerful lethal action, or to some commoner microbe acting upon tissues deprived of their vascular or nervous supply.

A remarkable case on which I operated a few years ago for Dr. Duncan Menzies shows how very well defined a gangrenous patch may be. Nineteen days after the first symptoms of an illness that seemed to be due to an ordinary appendicitis, when the inflammatory symptoms had completely subsided, I found two perforating holes in the appendix wall, one being an irregularly oval opening nearly half an inch long (Fig. 1). The edges were granulating and it was obvious, particularly in the larger gap, that a piece of the wall was wanting. The appendix which lay near the middle of the pelvis was universally adherent to small intestine, but it was so very easily separated that I brought it out of the abdominal cavity quite easily through a short incision without seeing the parts. The adhesions offered no resistance to the finger anywhere and it was only when the patent gap in the appendix wall was exposed to view that any unusual condition was recognized. The two openings were close together and a place on two coils of intestine which had closed them was easily recognized, as it constituted a granulating surface. Many coils of small intestine were lightly adherent, but easily separated.

If the openings in the appendix had been due to an ulcerative action beginning in the mucous membrane in this case, the adhesions must have been very much more firm; and it seems to me impossible to avoid the conclusion that two pieces of tissue died, became separated, and were discharged through the appendix, the general surface of the peritoneum being protected by adhesions of the intestine. The lumen of the appendix was wide and unob-

structed and the patient's safety lay in the free exit for its contents thus available. Whether the gangrene formation was primarily due to a vascular or nervous change, or to the action of a microorganism, or to a combination of these conditions, there does not seem to be sufficient evidence to show.

When I operated on this patient she appeared quite convalescent and there were no signs by which the exceedingly dangerous condition that existed could be recognized. Indeed, if there had not been a history of two attacks, an operation might not have been performed, in which case when the patient resumed her ordinary mode of life, one of two things must have happened. Before the gap in the appendix healed the slightly adherent coils of intestine might have become separated by some drag on them due to a peristaltic or other movement or by an increased pressure within the appendix. An acute condition would have arisen immediately and the true explanation would not have been obvious and could hardly have been recognised, for I think this is the first case on record in which it has been possible to trace clearly the sequence of events. Indeed, if the acute condition suggested had supervened and if an immediate operation had been performed when the patient was very ill and when the parts were involved in a recent inflammation, perhaps with extravasation of fæces, the obvious but erroneous deduction might have been drawn that a large perforation could occur in the appendix wall almost instantaneously. On the other hand the parts might have healed, the loosely adherent intestine might have become free, or the adhesions might have become dense and hard, whilst a cicatricial contraction of the appendix would have gradually formed, the true cause of which it would have been difficult to state.

It seems to me that the explanation of this case which I have suggested offers a more adequate interpretation than has yet been given of many histories in which a clean-cut perforation of the appendix wall or a sloughy opening has been found within a few hours or days of an acute attack of pain.

One of the most important points for consideration when a necrotic patch is found in the wall of the appendix is the date of its death. Clearly if the tissues may die without symptoms, the onset of symptoms does not necessarily herald their death and therefore it may, in an individual case, be hard if not impossible to say when necrosis took place. In the last case I have mentioned, there was an attack of inflammation lasting about ten days, and nine days after the symptoms had completely subsided there were two granulating gaps perforating the appendix wall. In the first case recorded in this paper, some four days after the first symptom the mucous membrane of the greater part of the appendix was separated from its muscular coat, but still adherent to the rest of the mucous membrane. In the lady, aged 71, whose case I have referred to, the gangrenous patches showed no sign of separation forty-four hours after the first pain was felt. In another case the appendix ruptured as I lifted it out of the abdomen from amongst most easily separated adhesions forty-two hours after a short attack of pain followed by a temperature which did not rise above 99° F. A definite gap was left in the wall of the appendix and I argued that the necrotic portion died at least forty-two hours and probably longer before the operation. Two of Finney's cases, quoted by Howard Kelly, seem to me to prove conclusively that the symptoms cannot indicate the date of death of the patches. In one the appendix was gangrenous on one side and "ready to perforate" within three hours of the apparent onset of mischief; whilst in the other, within six hours of the initial complaint, there was a spreading peritonitis and there was every reason to believe that the very first pain the patient felt was occasioned by the perforation.

In conditions in which the formation of sloughs may be observed, as when they occur on a surface of the body, their separation takes place at very varying times, but never immediately. Soft structures, such as loose connective tissue and fat, are thrown off quickly; fibrous tissue, tendon, and bone more slowly.

A suppurating action certainly facilitates separation. Occasionally, at the edge of a surgical wound, for instance sometimes after a mammectomy, when there has been much tension, it may be observed that a little bit of skin close to the incision has died. If this

remains dry, it separates very slowly. I have seen such a piece of dead tissue become a scab which was thrown off only when healing underneath was completed. If suppuration takes place, the separation is usually much more rapid.

Hence the degree of separation of a slough does not indicate with any exactitude the period of its existence which, therefore, so far as I know, remains uncertain in appendix cases, even after the parts are exposed.

The nature of the symptoms first developing also varies. There may be an accompanying inflammation with pain. Anything which causes tension between the dead and the living tissues must excite pain which may be temporary if the tension is quickly removed, as by an escape of fluid into the cæcum, but if the tension is not relieved the pain will persist. If the adjacent parts become adherent, a separation of the adhesions by a movement of the body or of the intestines or by tension within the appendix may cause pain. If the appendix does not become adherent, an insidious peritoneal irritation arises, with first a serous and later a suppurative inflammation, sometimes for a time causing no pain; and thus we may explain those obscure cases in which the peritoneal cavity is found full of pus and the appendix is gangrenous and perforated, although there have been hardly any symptoms except those of paralysis of the bowel.

From a careful consideration of all the facts, it seems to me that in the case recorded at the beginning of this paper at some time, perhaps many years ago, changes took place which induced peritoneal adhesions around the appendix. Possibly there were no symptoms, or the illness may have seemed so trifling that no doctor was consulted and the patient forgot all about it, or it may have caused only one of the common abdominal aches of childhood.

On or before November 4, 1907, the greater part of the mucous membrane of the appendix died, probably because of the action of some microorganism. If the tissue died because of vascular or nervous changes, it was quickly invaded by septic microbes. The earliest symptom was the eczema due to absorption of toxic products. Two days later slight tension and tenderness arose from swelling of the mucous membrane at the junction of the appendix with the cæcum, or from an accumulation of serum between the dead and the living tissues, and, after nearly two days more, a septic inflammatory condition began to extend with severe pain.

It is obvious that, if the explanation of the conditions which I have suggested is the correct one and if we could have known what was going on before the operation, we would have removed the appendix four days earlier. Such a procedure was of course quite out of the question during the two days when there was no sign except the eczema. The observation of that symptom is, I think, unique as an indication of appendix mischief, but it is by no mean uncommon for a patient suddenly seized by appendix trouble to have felt decidedly ill for a few hours or even days before definite symptoms arose. This malaise is in all probability due to absorption of poison into the system and it is not remarkable that, in an individual case, such poisoning should give rise to an acute eczema. The fact that the patient suffered from that disease before and after the illness requiring operation does not minimise the significance of the association of an attack of eczema with a condition likely to give rise to a septic absorption.

When the pain in the side came on, if we still assume that my explanation is correct, there is no doubt that an immediate operation was desirable. But the significance of the eczema —the evidence of septic absorption — on which I now lay much stress was not so apparent even immediately before the appendix was removed as it was afterwards. If we leave out of consideration the interpretation of the symptoms which has been evolved since the operation and consider the facts from a clinical point of view before the abdomen was opened, it would appear that surgical treatment was arranged very promptly in this case, and Dr. Hewetson is to be congratulated on having decided upon it so early. Indeed, he could hardly have arranged it sooner unless he had acted on the teaching that as soon as appendix mischief is suspected the abdomen should be opened. There are undoubtedly cases of so-called fulminating appendicitis, in which such prompt interference is absolutely neces-

sary. I think the patient under consideration escaped such an attack only because the appendix was already adherent before the illness above described began, and my chief object in recording her history is to emphasize one of the most important causes of the well-known difficulty in diagnosing these conditions, namely, that microorganisms exist, and are not infrequently met with in or near the vermiform appendix which have the power, perhaps only under peculiar circumstances, of killing the tissues locally without causing any symptom whatever except those which are secondary to the gangrene formation. These are not pyogenic nor fever-producing organisms and the condition created by their action is not primarily an inflammation, but a gangrene of a part of the appendix wall. Their effects are therefore not included in a strictly scientific sense amongst those of appendicitis.

THE NATURE OF THE CANCEROUS PROCESS [1]

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WHEN, for example, some forty thousand people die in Germany each year of cancer, and in the United States nearly as many, the disease is stamped with an importance which justifies most untiring and patient investigation; and, although this is so difficult and the condition itself so mysterious that it has as yet baffled the work of the best investigators, we nevertheless appear to be approaching a solution of the problems it offers and to be accomplishing enough to feel more and more encouraged. We may still believe with Virchow that carcinoma is an epithelial neoplasm, whose component cells are not conforming themselves to normal habits or appearances. Around this truism the orthodox pathologists and histologists have built a number of theories, endeavoring to explain the reason for such changes. And thus, at the autopsy table and in the laboratory, they continue to gaze through brass tubes and bits of beautifully polished glass, seeking in this way to-day to find the answer to the most difficult problem in pathology. And while doing all this they have been studying mainly its terminal condition, coming into little or no personal contact with the disease in its early and living forms, and having little, if any accurate concept of it in the living, while failing to be struck by the evidences of infectivity which every observant clinician cannot fail to note.

There are far too many who look to the great masters and great internists with contemplative honor and regard them as infallible, so powerful is the influence of authority; but those who have furnished the dominant ideas of times past have each been the children of their day who, like other children, have erred in many directions. The earliest observers lacked in preliminary training and in instruments of precision; but we do not, for instance, hold Aristotle in less esteem because he believed that meerschaum was made from the foam of the sea, nor Bacon because he accepted an equivocal generation. Even in our own time we are too much concerned with the weight of authority.

It is very easy to say with Virchow that there is an irritation which provokes cells to act as they do in cancer, but far more important is it to determine the nature of the irritating material. Again, it is most strange that men who are perfectly willing to believe a contagium vivum in most other diseases are so loth to accept it in cancer. When dealing with infectious diseases what matters it whether one speaks of a definite morbid entity, of fermentations, or of chemical substances? They are the secondary factors. Without the

[1] Read before the International Society of Surgery, Opening the Symposium on Cancer at their Second Triennial Meeting, in Brussels, Belgium, September 21, 1908.

existence of certain parasites in the world certain disease forms would not exist. Should one destroy every living parasite the disease would be absolutely banished from the earth. But Virchow's influence is still so strong that men are attracted by his doctrine of the cells, and by it alone, and if the existence of a parasite must be acknowledged, they can see in it only some form of cells masquerading as such. The greatest trouble lies in this: that much of what Virchow saw and even accurately described he failed to accurately apprehend. This is true, for example, of his physalids which have been proved to be nothing but vacuoles or degenerative products.

Historically it is most interesting that in the very first volume of Virchow's Archives he should have presented a paper on "The Evolutionary History of Cancer along with Remarks upon the Formation of Fat in the Normal Body and Its Pathological Resorption." Thus he was almost the first man to describe cell inclusions with any approach to accuracy, and yet he completely missed their significance in this disease, as well as their character. The man who gave the real impetus, not merely to the proper study, but the proper interpretation of cell inclusions was L. Pfeiffer, to whom is really due the credit of priority in this direction; his great work and atlas being a monument to his own industry and his power of apprehension.

Thus it is largely the deference with which the orthodox laboratory worker has regarded the cell doctrine, and the teachings of Johannes Müller and Virchow which have caused him to direct his attention solely to the evolution, the life history, the behavior, and the habits of the cell, while seeking for intrinsic causes, whereas everything about the clinical picture, as well as all the suggestions which analogy offers as to extrinsic causes, have been disregarded or ridiculed. Moreover these laboratory workers have been blind in that they have refused to see what the microscope might show them, and have been far less inclined to the infectiousness of cancer than of leprosy, for example, or almost even of syphilis, conceding it to several other diseases whose parasites are not yet known, and yet against which they take every precaution.

About two hundred and fifty years ago, with only the knowledge and the narrow views of his day, Tulpius, the Dutch anatomist, (who is a prominent figure in Rembrandt's picture, "The Anatomist") made this statement: "Cancer is just as contagious as inflammation of the eyes." Junker, in 1731, maintained that cancer was contagious, and Harvey, the Great, wrote that tumors strongly resembled parasitic productions in the vegetable kingdom. These were broad statements, made purely from observation, by great men in times past.

This is an International Association of Surgeons and Surgical Pathologists. What interest for us who have to treat the living patients can be afforded by the disputes or the theories of those who can find satisfaction, or even satisfactory explanation for time consumed and wasted, in considering the phenomena of inflammation, or disturbed secretions or diet, or of altered blastema, or good blastema gone wrong, of good epithelial or connective tissue which has succumbed to some evolutionary or atavistic tendency and in consequence grown abnormally, of epithelial cells whose static internal conditions have been in some way disturbed, of the attractive theory of Durante and Cohnheim, of the newer views of Bütschli, Hansemann, or Ribbert, of anaplasia, cataplasia, or metaplasia, of irregular or too rapid mitoses, or of a specific cancer cell, which latter is not the least absurd of all these theories?

These were, or have been, the views of lame and impotent theorists who, failing to note, for example, analogies daily afforded by contrasted cases of surgical tuberculosis and cancer, have cheerfully accorded to the former an import and character which they deny to the latter. It is high time that we, as surgeons, become impressed with the undeniably infectious and now fairly well demonstrated parasitic character of cancer and undertake an active propaganda against the nonsense which has been so widely published.

Involvement of surfaces constantly in contact is known to afford frequent instances of transmission of cancer, particularly of epithelioma; as, for instance, about the mouth and the vulva. Bergmann emphasized the possi-

bility of transmitting cancer from one lip to the other, and various authors have shown how the same thing occurs in the larynx. Kauffman has seen cancer conveyed to the eyelid from the globe of the eye, and Fenwick has noted its transmission from one surface to another in the bladder. Constant and immediate contact is not always necessary for this purpose, as such lesions about the lip and mouth demonstrate. Further illustrations of this kind of transmission are seen in cancer of the stomach, produced by swallowing cancerous vegetations from the œsophagus, of which cases have been reported by Cornil, Klebs, Luecke and Menetrier. Cancer of the œsophagus penetrating the trachea has also produced lesions in the lung by the same kind of mechanical transmission, while Schimmelbusch has reported cancerous infection of the lip through the finger-nails of the individual who was handling his cancerous ear.

Hence I shall take the position that our time is wasted in discussing this disease from any other aspect. I would simply pay a surgeon's compliments to those who find it necessary to imagine a specific cancer cell of spontaneous origin, or a parasitism of epithelial cells, and to those who seriously believe any epithelial cell can become a parasite or act like one from any innate tendency or intrinsic cause.

These men are delaying progress and making regular pathology ridiculous in that they are making far heavier demands upon the imagination and far deeper inroads upon the truth than can be made by any reasonable presentation of and insistence upon the parasitic theory. It is to-day the only theory that really offers explanations of actual value for most of the phenomena of cancer in the broadest sense, and while men brought up under the old regime accept it with difficulty or not at all, it is constantly gaining ground in the esteem and acceptance of the younger men whose minds have not been already prejudiced under the older teaching. What explanation, for instance, can be offered for a sudden local epithelial rebellion except an invasion by some intruder from without? [1] This is the crux of the question and seems to permit of but one answer.

What, then, are the principal reasons for believing in the infectivity of cancer? This question may be answered from either the clinical or the experimental side.

A. Clinical.· 1. Direct transmission from a diseased to a previously healthy area, as from lip to lip. or during operation, as when tapping for cancerous ascites.

2. Cancer à deux, as from wife to husband, from patient to laundress.

3. Cancer houses, i. e.— homes in which there have been so many deaths from cancer as to make it appear most probable that the dwelling itself is in some sense infected.

4. The epidemic appearance of cancer within limited regions. Studies and demonstrations have been made in various parts of the world which have abundantly demonstrated the fact that there are many limited areas in which cancer is abnormally prevalent, and hundreds of homes in which several deaths from this disease have occurred.

5. Metastases. Brand believes, with me, that a strong argument in favor of the exogenesis of cancer is the occurrence of metastases and its termination thereby, and this although the cell with its. contents is transported, and not the germ alone. He says: "Although cancer is unquestionably purely local at the outset, it unfortunately does not remain so. Indeed, it would be completely under the control of the surgeon's knife, and would lose all its terrors, were it not for the fatal metastases which invariably happen and with a startling rapidity." Lockwood has shown that these occur more frequently and more early in organs which have no capsule, like the mamma, tongue, or pharynx.

Furthermore, cancer cells possess a most remarkable growth-energy of their own which is not to be explained by an intrinsic cell peculiarity, but must come from an external source and which is closely connected with their capacity for penetration and infiltration of the adjoining tissues.

B. Experimental. From the experimental side we may bring forward the following cogent arguments without exhausting the subject:

[1] One of my most recent personal experiences in this direction concerns a woman of fifty-five with cancer of the uterus, who lives in a little farm-house where she has within a short time cared for a father who died of cancer of the face, a sister who died of cancer of the breast, and another relative who must have had cancer of the stomach.

1. The analogy which exists in the vegetable kingdom between the xylomata and other tumors of trees and plants and the production of innocent growths, benign tumors, i. e., galls, well known to be the result of extrinsic irritations.

There is analogy also to be noted between all sorts of tumors in animals, and the more we study such lesions, as well as the infectious granulomata, including their metastases, the more striking does this analogy become.

2. Epidemic appearances of cancer among animals, such as have been reported by many observers. A few illustrations of this fact will suffice. Gaylord, for instance, has recently made a most interesting report of cancer cages used in the Buffalo Laboratory, i. e., old disused cages in which rats with sarcoma of the thyroid had been kept for some time. After being disused for months they were again used, without careful sterilization, to contain healthy rats, nearly all of which became infected, and developed sarcoma of the thyroid such as their predecessors had. Again Pick has shown that cancer may occur as an endemic in brook trout hatcheries, the thyroid being especially involved. He found that certain hatcheries were entirely free, while in those where fish were infected the disease was confined to those tanks or pools in which they were kept. When wild fish were introduced into these same pools in order to replenish stock they quickly acquired the disease, which was, in effect, a true carcinoma.

3. The actual transmission between animals of the same species of unmistakable malignant tumors. For example, Loeb and Jobson, in 1898, called attention to the endemic occurrence of cancer in cattle. This is one of the earliest observations of the sort, the most notable previous record being that of Hanau. In the history of the transplantation of animal tumors, aside from the very early efforts of this sort, such as those of Nowinsky in 1876, the classical experiments of Hanau in the transplantation of carcinoma of the rat and the much-neglected but extensive experiments of Morau, Loeb's elaborate and extensive transplantation experiments with rat sarcoma are entitled to far greater consideration than has been accorded them, especially in Europe. Without detracting from the value of Jensen's work, which is generally accredited with being the beginning of modern experimental investigation in cancer, it should be realized that in America Loeb, whose work appeared in 1902, really carried out the first elaborate series of investigations, based upon the experimental biological method of studying tumors by means of transplantation. He, moreover, determined that the transplanted tumors grow from transplanted cells, and added to his work much research concerning the effect of external agents and artificial conditions upon the growth of such cells. Transplantation of tumors, therefore, through the stimulus given by Loeb's work, took a very early foothold in America, and, aside from his own work, which extended from 1899 to 1903, active transplantation of mouse tumors was first taken up, through the courtesy of Professor Jensen, by the New York State Laboratory, Buffalo, in 1904. The attention of the workers in this laboratory was at once directed toward studying the immune phase of the question, with the result that in January, 1905, Gaylord and Clowes were able to announce the discovery of the fact that a considerable percentage of animals recover spontaneously from inoculation tumors, that they are then immune and that their blood exerts a definite immunizing effect on animals into which it is injected. This is the first demonstration of a positive and reliable immune phenomenon in these animals. It is true that Jensen produced variable results by injecting cancer material into rabbits, employing the serum of such animals upon mouse tumors, but in the light of the frequency with which spontaneous recovery occurs in animals, and the effect of almost any procedure upon small tumors, it is questionable if in reality he succeeded in demonstrating any actual immune phenomenon. *Gaylord and Clowes were the first to demonstrate the high percentage of recoveries in cancer mice, the immunity of these animals after recovery, and the establishment of the fact that the blood of such animals possesses immune qualities.* This work was antedated, in certain respects, by the observations of Smith and Washbourn, who observed a similar state of affairs, in 1889, in

a lympho-sarcoma of the dog, but the work in Buffalo was entirely independent of the observations of Smith and Washbourn, the tumor which they studied at that time not being recognized as a malignant tumor. These investigators also did not observe the fact that the immune process was expressed through the medium of the blood. The work of these American observers antedates by more than a year the work of Ehrlich, which has received such extensive recognition. Their observations have at the present time received practically universal confirmation in all the laboratories of Europe.

In addition to the above evidence, there are the peculiar tumors occurring on the generative organs of dogs, transmitted *in coitu*, apparently with surprising readiness, as well as by experimental inoculation, and which are probably lympho-sarcomata or some allied growth. These have now a widespread interest because they have been observed not only in America and Europe, but recently in New Guinea, and, as I have been lately informed, by Dr. W. F. Arnold, U. S. Navy Surgeon, who saw the same growth in dogs in Yangkow, in Northern China, in 1894 and 1895. (Personal communication.) He there proved their communicability *in coitu*, but lost his specimens on the return journey to the United States. These are the tumors to be alluded to below in which Crile and Beebe have had such striking success in bleeding the animals freely and then transfusing blood from a dog which had become immune to such growths by spontaneous retrocession or by artificial insusceptibility.

4. Occasional successful causation of tumors by injection into animals of human products. In this effort Langenbeck was probably the first to succeed by injecting cancer juice into the femoral artery of dogs, the animals dying of unmistakable cancer of the lungs, and this experience being duplicated by Follin and Velpeau. It must be granted, however, that these experiments have rarely succeeded. Nevertheless to those which have been successful due importance must be attached.

5. The occurrence of many thousands of successful inoculations between animals of the same species, as has been proven in Buffalo, in London, in Frankfort, in Paris, and in numerous other laboratories.

6. The general behavior of the disease, namely, its resemblance to other known infectious conditions, with its reactions to certain serums, its tendency to hæmolysis, its behavior to transfusion, its ending by some terminal infection, and all the other well-known evidences of infectivity.

Loeb even believes that tumors may be classified as follows: *a*. Those that can be transplanted into other species than that in which they originate; thus the peculiar lympho-sarcoma of the dog, above mentioned, has been made to grow in the fox. *b*. Those that grow only in members of the original species, in hybrids or in closely related varieties. *c*. Those that will grow only in the same variety as that in which they originate; for instance, Japanese mice, whose tumors cannot be transplanted into white mice. *d*. Those which cannot be transplanted even to other members of the same species, including a large proportion of tumors in lower animals and probably in man.

Ewing, Beebe and Crile have further developed the observations, first made in Buffalo, by applying the principles of the discovery to the dog tumors extensively studied in Europe by Sticker, and in England by Bashford. These American observers found that by using transfusion as a medium the blood of immune dogs can be rendered more effective by the employment of a large quantity, and they have in this manner succeeded in curing a large number of animals, almost without exception in the last stages of the disease, by transfusing them with the blood of recovered immune animals. The importance of their observations, like so many of those made in America, has thus far failed of sufficient recognition in Europe.[1] The dis-

[1] Clinical Transfusion and Serum Reaction in Carcinoma and Sarcoma, by Crile. (Journal American Medical Association, January 4, 1908, p. 63.) Crile reports a case of exsanguination due to hæmorrhages in connection with jaundice caused by a carcinoma of the gall-bladder. A large amount of fluid was transfused. The tumor continued to grow, although the hæmorrhage was controlled, and there was no evidence that transfusion exerted any influence on the cancer. Following this, eight other cases of carcinoma were transfused, there being no evidence of any influence on the actual course of the disease in any of them. Four incurable cases of sarcoma were transfused, two of them being so far advanced as to be inoperable, while two of them underwent removal of the greater part of the growth. No definite results were learned. In fifteen cases of carcinoma and sarcoma Crile and Beebe confirmed the observations of previous workers that hæmolysis occurs in cases of malignant tumors. This is important since

covery of the development of sarcoma in the course of transplantation of epithelial tumors, made by Ehrlich, was simultaneously made in the United States by Leo Loeb. In 1906 the Buffalo Laboratory also entered this field of experimental work, and its staff have already published several papers on inoculable tumors in mice, being also at present engaged in studying various phases of heredity. The Rockefeller Institute has also added recent results of extensive experiments with sarcoma of the rat, the most noticeable of their observations pertaining to the fact that in certain instances emulsions of these tumors heated to 50°C. and injected into animals, will increase their susceptibility to inoculation in marked degree. This experiment is an elaboration of a fundamental discovery made by Clowes in the Buffalo Laboratory, in 1906, who found that subjecting inoculable cancer material of low infectivity to incubation at 39°C., for a period of half an hour previous to inoculation, increases its virulence, while similar incubation of very highly infective material reduced the same.

The Buffalo Laboratory has seriously attacked the question of parasitism in cancer and published an extensive series of studies bearing on cancer cell inclusions, as well as comparative studies of the plasmodiophora. Simultaneously with Bosc the analogy was recognized between smallpox and cancer, while the endemic occurrence of cancer in animals and its distribution in certain districts were given early consideration. The biological side of cancer has also been carefully studied by Professor Gary N. Calkins, of the Buffalo Laboratory, who published articles on cancer cell inclusions, and later, in conjunction with Gaylord, on spirochætes found in cancer mice. In addition, he recently published an important contribution on the rhythms of growth energy in cancer, in which he shows that rhythms of such growth pertain not to the cells but to fluctuations in the infectivity of the cancer material itself.[1]

7 The same tendency to metastasis, with the same explanation as occurs in other infections, and the same rare tendency to spontaneous retrocession which has been noted in human cases.

8. The practically complete demonstration that in animals it is an infectious disease and the unavoidable inference that if it be so in them it must also be in man.

Behla, than whom we have no keener nor more accurate observer, believes it experimentally proven that cancer is due to a parasite and that this organism belongs to the chytridiaceæ; i. e., that it is a vegetable organism on the borderland between the vegetable and animal kingdoms, belonging perhaps, among the phycomycetæ. If so, it enters the blood through the skin or the mucosa. Its spores penetrate epithelial cells, and then cause enlargement of their nuclei with asymmetrical mitoses; later they produce a proliferative irritation. The infected cells work their way into connective tissue, their parasites growing meantime within them, collecting in minute heaps, while their interior becomes cloudy, and finally there is found a sporangium, either within the cell or close to it. These sporangii are the round bodies which have been recognized under the lens. After attaining this stage they commence again a new life cycle. They are found in degenerated portions of the growth, as well as often

they had seen hæmolysis in some of their earlier transfusion cases. They wished, also, to determine whether or not this might afford a method of diagnosis as suggested by Peskind. In all but two of the cases of sarcoma, there was hæmolysis, which was present also in all of the cases of sarcoma, the degree depending apparently on the extent of the disease. It is interesting that two cases of advanced sarcoma which hæmolyzed normal blood did not hæmolyze each other. Various combinations were tried. One case of a very large breast tumor, considered malignant, but supposed to have been originally benign produced no hæmolysis, and on operation the tumor was found to be benign. A very extensive case operated five years previously was suspected of suffering from recurrence. Her blood showed no hæmolysis and careful physical examination did not reveal any evidences of recidive.

[1] Calkins worked out a very suggestive topic when he considered the rhythms of growth energy in mouse cancer. It was the result of his studies of the Jensen mice, during which he established that there are periods of growth activity which alternate with periods of depression of vitality in more or less rhythmical intervals. Plottings made from these subjects show curves of alternating growth waves which make the matter undeniable. Calkins, therefore, holds to the view that there is a regular variation in the energy of growth of a cancer whose cause must be sought within the cells. He points out that these cells receive their nourishment as do other epithelial cells, are surrounded by the same fluid, and are subject to the same general conditions, but that the other epithelial cells do not multiply as do the cancer cells proper, and that the cancer problem, then, is to really distinguish the source of the stimulus, which causes this difference of activity among the cells. He argues that the cancer cells themselves must carry with them the source of their stimuli, and that these must be the same in both primary and secondary tumors, and that if it be found that the rhythmical variations thus noted are comparable to what one finds in the life history of some of the unicellular organisms the conclusion seems inevitable that the source of the stimulus is within or associated with the cancer cell. At all events, he regards it entirely as a biologic problem which is not explainable by the Cohnheim theory, neither by the views of Ribbert, nor by the chemical theories of Marchand, which do not account for an unusual stimulus with gradual loss of energy. Therefore, Calkins argues that the cause of the division of energy, lies in the stimulating poison of some self-contained and ordinarily invisible microorganism, whose rhythmical variations in vitality may possibly account for the rhythmical variations in infectivity.

in the mitoses. Some of these parasites produce or take up pigment, and thus is produced melanotic growth. The question why the adjoining epithelium does not participate in the growth he answers by presupposing that the parasites produce an enzyme and that it is only young and fresh parasites which can penetrate a young proliferating cell.

Even many of our forefathers perceived the unmistakable evidences of infectivity, at least in ulcerating cancer cases and adduced ample illustrations. In the seventeenth and eighteenth centuries cancer was often held to be as infectious as phthisis. Lebert held to the contagiousness of cancer, and was evidently particularly struck by the case of a retained fœtus, the mother dying with carcinoma of the peritoneum, while the abdomen of the fœtus was itself filled with gray and gelatinous masses which Lebert pronounced cancer.

Even when the blastema theory was so popular this view was held by many observers. At that time the disinfection of residences of cancer patients was urged by many — among them Gueillot [1] who urged that the house in which a cancer patient has died is contaminated and should be disinfected. Budd [2] reported numerous instances of direct transmission, and similar collections have appeared in number, especially those of Hale,[3] Trosh [4] and Martin.[5] It is enough to say that there are now hundreds of cases on record which put the possibility of contagiousness of cancer beyond the pale of doubt.

Next, we have to deal with the fact that there is absolutely no special carcinoma cell, since to acknowledge this is to believe that there was an original neoplasm from which it came and to thus simply push back the basis of the question. In other words, it would not show from whence came the first carcinoma cell. Moreover, in this event all cases of cancer would of necessity be due to direct contact, and all would be of only one variety, namely, that from which the cell emanated, all of which is in opposition to the known fact that but a relatively small number of cases of cancer are as yet known to be due to direct contact, most of them arising with an appearance of spontaneity. Moreover, it is also characteristic of cancer that its variety is very great, which is to be explained in some other way than by the direct implantation of a carcinoma cell, or by the preposterous statement that any somatic cell, by any intrinsic stimulus, can possibly develop *de novo* a specific disease such as cancer. We might as well be told that tuberculosis is due to the agency of an intrinsic stimulus.

Clinical evidences enough being at hand, then turn we to the experimental side. The original canons of proof required to demonstrate infectivity called for the cultivation of the specific germ and the reproduction of the disease by inoculation with the cultivated organism. It has become impossible to fully comply with these in the study of cancer for the following reason: Cancer is known to be inoculable only or almost solely between animals of the same species. Though widely prevalent among domesticated animals and known among the wild, there is nothing to prevent experimenting with them, but with human beings it is quite different. Our only evidences of transmission between them must be clinical, since sentiment prevents that experimentation which might settle the whole question. This I hold to be a false sentiment, since I believe that hardened and condemned criminals should be subjected to such investigation, and be thus made to render their tribute for the benefit of others. Why should we merely brutally execute them when something of great value might be learned from them?

This limits us then to the argument of analogy. If we can prove infectivity in animals we have more reason for conceding it among mankind.

Nor have we as yet been able to cultivate the parasite, not at least in the ordinary acceptance of the term. Moreover, we cannot yet with absolute certainty describe or identify any particular organism as the specific germ. So let us be frank and acknowledge we are not yet prepared to announce a final discovery, nor need we here rehearse the nature of the difficulties which have so far prevented such

[1] Union Méd. du Nord Est, 1891.
[2] Lancet, 1887.
[3] Med. News, October, 1885.
[4] Practitioner, 1899.
[5] Boston Med. & Surg. Jr., Aug. 20, 1894.

announcement. Therefore, it has not been possible to cultivate the elusive germ and reproduce the disease with pure cultures, nor has it been possible with scarlatina, measles, smallpox or syphilis. And as yet no man has been able to cultivate the plasmodium of malaria or the germ of yellow fever. Yet who hesitates to acknowledge a high grade of infectivity for each of these?

So the canons of Koch demand too much when dealing with diseases of man not directly transmissible to animals, of which cancer and syphilis are perhaps the most common and conspicuous illustrations. Therefore we should not demand the impossible, but rather make more of that which is possible by being less blind and making better correlation of facts.

Behla declares himself as a "protestant krankologe" as against the dogma of authority, against which even Virchow protested, but of which his followers have been, perhaps, the most ardent disciples. If cancer is to be regarded as a constitutional disease there is but very little use in operating, since in that case there would be almost as much reason for amputating the foot of a gouty patient. On the contrary, we know regarding cancer, that thousands are cured by early operations when the proper measures have been taken. If cancer were a constitutional disease, why should the general condition improve and there be complete restoration to health after an extirpation properly made, or why should there not occur at very many points the same cell grouping and characteristic proliferation which we see when it does return? If it really be constitutional it is always such, and while too frequently recurrence does take place it is because of an early metastasis or a late operation, instead of the reverse.

From all that we can learn it would appear that absolutely healthy tissues are almost, if not quite immune from or invulnerable to cancer parasites, and that there must be causes predisposing to the acquisition of the disease which include whatever lowers or impairs the powers of resistance. In the case of cancer it may be that the most important factor in this direction is tissue degeneration from any cause, particularly that due to obsolescence of organs or to general senility, since it is undeniable that cancer is still a disease most prevalent during the latter part of life, although by no means confined to it. If, however, decay occur in excess of repair, when tissues are unequal to the strain of resisting the invasion of parasites, and especially when this occurs along with other predisposing factors, including irritation, traumatism, or inherited susceptibility, then conditions favor the development of cancer.

These parasites seem to be practically omnipresent. Our relationship with our neighbors, including those suffering from cancer, is closer than is generally appreciated. All of our food, raw or cooked, passes through many hands and its absolute cleanliness is beyond our control. While this is generally recognized with regard to other infectious diseases, it has scarcely been thought of with regard to cancer. Much of the fresh vegetable food which we eat is gathered by unwashed hands and never cleaned, while much of it again is readily accessible to animals of all kinds, which suffer from external cancer as well as from various parasitic intestinal and other diseases. Infection by insects, flies, and bedbugs especially is almost unavoidable. There is good reason to think that flies may be regarded as carriers of this infection, as well as of so many others.

Moreover, as Brand has reminded us, neither degenerative tissue nor other animal tissue cells can proliferate without a specific stimulus. Thus the ovum only commences to develop after its invasion by the spermatozoon which acts as an extrinsic specific parasite, the resulting proliferation being enormous and rapid, although the resulting tumor is benign.

The result of the subjection of various tumors to the action of liquid air for a period of twenty to forty imnutes would show that, in spite of the exceedingly low temperature thus produced, inoculations made with the frozen material are almost as successful as those made under ordinary temperatures and that liquid air does not destroy the potentiality of the active agent. This naturally suggests the existence of an independent virus, capable of retaining its activity outside the body, as

well as inside, after being subjected to this extreme cold.

Finally, how then are we to regard cancer and treat it? It seems to me that every alert surgeon must ally himself with thinkers like Brand, who hold that cancer is emphatically a specific disease, intensely infectious to the individual. Granting these facts, there is but one logical conclusion and that to the effect that cancer is both transmissible to others and that it is caused by an extrinsic agent. In fact, in almost all respects it closely resembles in origin and evolution a chronic infectious disease, save for its early local manifestations and the fact that its cells are transported, at least in large part, as well as the infective agency itself.

Holding to these views, cancer must be treated much as we would treat a filth disease, especially when it has advanced to the ulcerative stage — namely, by the most efficient cleanliness. Cremation should supersede earth burial, and all soiled dressings and discharges should be destroyed by fire, while rooms and even houses inhabited by cancer patients should be most thoroughly disinfected, both during illness and after death. It would be well, also, to adopt Brand's suggestion that no food should be prepared or consumed with unwashed hands.

In addition to this, it would appear that in some respects at least we ought to be at an advantage in treating this disease, since its earliest manifestations are local. Unfortunately, and in contrast with this fact, stands this other that unless the cancerous lesions be visible or palpable there is nothing about them by which they can be distinguished from other infectious lesions, especially in their early stages. We may regard it as established that cancer is essentially a local infection, at least at first, which becomes more or less quickly generalized, the rate of spread varying wonderfully with different individuals and with different types of growth. Could one recognize it while still purely local, and could he thoroughly remove it with a wide zone of surrounding tissue, cancer would be, as it is in effect under these circumstances, a curable disease. This is proven by the constantly increasing ratio of success under this method of management. *Sad to say, cancer is a disease without a symptomatology of its own, and is to be recognized only by signs* which are appreciated and duly recognized, in most instances, at a period too late to permit of the application of radical surgical measures. This aspect of the disease is one which has apparently attracted as yet but little attention, and yet it is the most important feature in the management of the disease, and offers alike the excuse for non-recognition as well as for failure in treatment. Nevertheless the fact remains that until some safe and reliable symptom of cancer in various parts of the body be given us, we shall still have to fall back upon the old surgical treatment, which should be made modern by its more thorough application, and this until such time as elaborate study, with experimentation upon human beings, may afford us some method of influencing parasitic growth and destroying the germ without necessitating the destruction of large amounts of tissue.

PUBLICATIONS FROM THE NEW YORK STATE CANCER LABORATORY

1. On the presence of a characteristic organism in cancer — presumably a protozoan. By Harvey R. Gaylord, M. D.
2. The importance of chemical research in investigations regarding the cause and methods of treatment of cancer. By G. H. A. Clowes, Ph. D.
3. Cancer distribution and statistics in Buffalo for the period 1880–1899, with reference to the parasitic theory. By Irving Phillips Lyon, M. D.
4. On the present status of the investigation into the etiology of cancer by the Cancer Laboratory of the New York State Board of Health. By Harvey R. Gaylord, M. D.
5. Plasmodiophora Brassicæ (Woronin). By Harvey R. Gaylord, M. D.
6. On the evidence of nuclear division of certain cell inclusions (Thoms, Sjöbring, Plimmer's Bodies) in cancerous epithelium. By Harvey R. Gaylord, M. D.
7. Suggestions for the biological study of cancer. By Gary N. Calkins, Ph. D.
8. Report of the biological chemical department. By G. H. A. Clowes, Ph. D.
9. Treatment of cancer. By G. H. A. Clowes, Ph. D., and Herman G. Matzinger, M. D.
10. A note on the toxic and vital theories regarding the causation of cancer and their bearing upon the parasitic theory. By G. H. A. Clowes, Ph. D.
11. Statistical study of a rural cancer district in the State of New York. By Irving Phillips Lyon, M. D.
12. A cancer district in the towns of Plainfield and Edmeston, N. Y. By Irving Phillips Lyon, M. D.
13. A report upon the physics and therapeutic value of kathode and ultra-violet rays, with reference to the

electro-magnetic theory of light. By Roswell Park, M. D., LL. D.
14. An epitome of the history of carcinoma. By Roswell Park, M. D., LL. D.
15. The cell inclusions in carcinoma. By Gary N. Calkins, Ph. D.
16. On the analogy between smallpox and cancer. By Harvey R. Gaylord, M. D.
17. Report of the biological chemical department. By G. H. A. Clowes, Ph. D.
18. Studies in cancer metabolism. By G. H. A. Clowes, Ph. D., W. S. Frisbie, Ph. B., and H. H. Glosser, M. D.
19. Chemical examination of the urine as a means of diagnosing the position of a tumor and observing the course of its development. By G. H. A. Clowes, Ph. D.
20. On the secretions of the stomach in cancer as compared with the normal. By G. H. A. Clowes, Ph. D., and E. W. Jeffcott, Ph. B.
21. On the reduction of starch iodide solution by means of the aqueous extracts of tissues. By G. H. A. Clowes, Ph. D.
22. A note on the influence exerted by X-rays on the metabolism of normal animals. By G. H. A. Clowes, Ph. D., and W. W. Plummer, M. D.
23. A note on the quantitative estimation of phosphates in stomach contents. By G. H. A. Clowes, Ph. D.
24. The relationship between the freezing-point depression and specific gravity of urine, under varying conditions of metabolism, and its clinical value in the estimation of sugar and albumin. By G. H. A. Clowes, Ph. D.
25. The metachromatism of mast cell granules and mucin. By G. H. A. Clowes, Ph. D., and Alice G. Owen.
26. The theory of indicators and its bearing on the analysis of physiological solutions by means of volumetric methods. By G. H. A. Clowes, Ph. D.
27. Preliminary report on the presence of an immune body in the blood of mice spontaneously recovered from cancer (adeno-carcinoma, Jensen) and the effect of this immune serum upon growing tumors in mice infected with the same material. By Harvey R. Gaylord, M. D., G. H. A. Clowes, Ph. D. and F. W. Baeslack, B. A., Med News, January 14, 1905.)
28. Preliminary communication regarding an immune body capable of inhibiting the development of cancer in mice (adeno-carcinoma, Jensen). By G. H. A. Clowes, Ph. D. (J. H. Bulletin, vol. xvi, No. 169, April, 1905.)
29. Ueber Metastasenbildung beim Adenocarcinom der Mäuse. By F. W. Baeslack. (Deut. med. Wochenschr. Jarg. 31, No. 24, June 15, 1905.)
30. Some Artefacts in Mouse Carcinomata. By Gary N. Calkins, Ph. D. (Journal Infect. Dis. II, No. 4, Nov. 1905.)
31. Further evidence of immunity against cancer in mice after spontaneous recovery. By G. H. A. Clowes, Ph. D., and F. W. Baeslack, M. A. (Med. News, Nov. 18, 1905, No. 21).
32. On the relationship between the rate of growth and the potassium and calcium content of mouse tumors (adeno-carcinoma, Jensen). By G. H. A. Clowes and W. S. Frisbie.
33. On spontaneous cure of cancer. By Harvey R. Gaylord and G. H. A. Clowes.
34. The influence exerted on the virulence of carcinoma in mice by subjecting the materials to incubation previous to insensation. By Clowes & Baerlack
35. A study of the influence exerted by a variety of physical and chemical forces on the virulence of carcinoma in mice. By G. H A. Clowes, Ph. D.
36. Evidences that infected cages are the source of spontaneous cancer developing among small caged animals. By H. R. Gaylord and G. H. A. Clowes. (Jour. Am. Med. Asso'n, January 5, 1907).
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HÆMORRHAGES FROM THE STOMACH AND BOWELS FOLLOWING OPERATIONS ON THE GALL-BLADDER AND APPENDIX

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A NUMBER of cases have come under my observation during the last few years in which, after operations about the gall-bladder and appendix, hæmorrhages followed which taxed all of our ingenuity to still. These hæmorrhages were both from the stomach and bowels, and of such severity as seriously to endanger the lives of the patients. They occurred within a few hours after the operation, and persisted varying times, in one case for nearly two weeks. In two of the cases the hæmorrhages both antedated and followed the operation, and were so persistent as to lead naturally enough to the suspicion of stomach ulcer, and in none of the cases cited were there hæmorrhoids.

A. J., aged 43, complained for many years of stomach cramps, in which the pain was localized in the epigastrium and back. The attacks were characterized by severe and uncontrollable vomiting, which only yielded to hypodermic injections of morphine. He had never vomited blood, nor had he noticed tarry stools. Upon examination there was pain localized over the whole right epigastric region, and especially marked rigidity of the right rectus. Furthermore, unlike in stomach ulcer, the attacks were characterized by *periodicity*, with months of interval from anykind of gastric distress between. For the above-mentioned reasons the diagnosis of gall-bladder disease was made. The operation, performed by Dr. L. A. Greensfelder, revealed a small, thickened gall-bladder, full of inspissated bile, but no stones. After complete extirpation of the gall-bladder, the stomach and pancreas were carefully scrutinized, and found to be absolutely normal. Directly after the operation, and continuing at intervals for several days, the patient began to vomit blood, at first bright red, later darker in color. Careful lavage with styptics and complete withdrawal of food soon controlled the hæmatemesis. After a few days, however, there were profuse hæmorrhages from the bowels, which soon placed the patient in a critical condition. The blood came occasionally mixed with stool. There were not only occult hæmorrhages, which could be demonstrated chemically and microscopically, but also a number of movements of pure blood of such color and consistency as to warrant our belief that they came from the bowel. These hæmorrhages continued with interruptions for some weeks, but finally yielded to treatment, and the patient went on to complete recovery.

The case of Mrs. Z., a Bohemian woman, was somewhat similar to the history of the one just cited. She was a stout, middle-aged woman, whose previous history was negative. For some years she had complained of severe pain in the epigastrium coming some hours after eating, and vomiting of blood. She could not state with any degree of accuracy the exact color of the hæmorrhages. She had lost somewhat in weight, but was on the whole well nourished. A physical examination showed extreme tenderness in the epigastrium, otherwise nothing of note. On account of the suspicion of ulcer, she was given a typical ulcer cure, with a few weeks of bed rest, but without relief from her symptoms. Finally, laparotomy was performed, on account of the suspicion that her symptoms might be reflex from the gall-bladder. At the operation a large occluded gall-bladder, filled with stones, was removed. The stomach itself was found in every way intact, and the most careful examination showed no ulcer, either fresh or healed. After the operation the patient had several hæmorrhages from the stomach and the bowels, but then went on to uninterrupted recovery, and has had no untoward symptoms since.

Mr. C., a Russian, had almost similar symptoms to those cited above, only his disease was of much longer standing. He had repeated attacks of hæmatemesis, pain, indefinitely localized over the whole upper abdomen, and was greatly emaciated, so much so as to allow us the justifiable suspicion of carcinoma. At the operation, although his gall-bladder was found badly diseased, we were also able to discover a healed ulcer at the cardiac end of the stomach. This ulcer, however, was perfectly scarified, and could in no wise account for his hæmorrhages. This patient experienced great relief from his operation and as long as he was under my observation was free from all his former stomach symptoms.

In the case of Mrs. C., who had been operated two years before, for gall-bladder disease, there was progressive emaciation, pain in the region of the liver, especially after partaking of a full meal, and persistent vomiting, the vomitus often being mixed with blood. At the operation the pylorus was found firmly bound down by adhesions to the edge of the liver, the pancreas normal; the stomach was freed, its raw surface covered with peritoneum, and the transverse colon stitched to the border of the liver, with the idea of keeping the stomach free. The patient made a good recovery, except for a few attacks of hæmatemesis directly following the operation, and has since been well.

Mrs. S., referred to me by Dr. E. Wyllys Andrews, was about fifty-six years of age, and greatly emaciated from repeated and extreme hæmorrhages from the stomach, covering a period of some three years. She complained of typical ulcer pains occurring some hours after eating, and of a severe boring character, radiating to the back. She underwent a number of ulcer cures,

without benefit, though on one occasion food was withheld by mouth for at least ten days. But in spite of all that could be done for her medically, the hæmorrhages recurred periodically. Physical examination was negative, except for a diffuse pain over the pit of the stomach. We finally decided that an operation was necessary as a life-saving procedure, but to our great astonishment the stomach and pancreas were found free from any pathological changes, whereas the gall-bladder was greatly enlarged and thickened, and full of stones and inspissated bile. Cholecystectomy was performed, with light drainage. Directly following the operation, and for ten days thereafter, the patient vomited large quantities of blood and passed masses of coagulated bloody stool. Neither this patient nor any of the others I have referred to had icterus, either before or following the operation.

Following operations for appendicitis I have also observed hæmorrhages from the stomach on several occasions, which continued for days afterwards. In none of these cases, however, has the patient succumbed, so that I cannot from my own experience look upon such hæmorrhages in the unfavorable prognostic light that the French school, especially Dieulafoy, has in the past. Lavage of the stomach and small doses of morphine controlled the hæmorrhages in all my cases.

I add a number of similar cases from the literature.

Schmidt reports the case of a 58-year-old woman, with a hard tumor in the right hypochondriac region. At the operation the gall-bladder was found filled with stones and adherent to the colon, omentum, and pylorus. The adhesions were loosened and the patency of the pylorus established by invaginating the anterior gastric wall through it. Cholecystectomy was performed. On the second day there was, first, blood-stained sputum, then hæmatemesis recurring twice. Some melena followed. The further course was uneventful.

Dehler reports a similar case, which clinically showed resistance in the right hypochondriac region. There had been several gall-stone attacks, but without jaundice. At the operation abscess was found between the fascia trasnversalis and the parietal peritoneum, with dense adhesions of the omentum, colon, and liver, and empyema of the gall-bladder. Cholecystectomy was performed, with light drainage. There was no tugging on the stomach or duodenum during operation, nevertheless there was hæmatemesis on the second day, which disappeared with gastric lavage.

Kehr cites three cases with a similar history. One, in which there was typical biliary colic with a tumor in the right hypochondrium; another, in which there was hæmatemesis on the second day, followed by uneventful recovery; and still another, in a 44-year-old physician who had for six years attacks of typical biliary colic. Aside from an apical tuberculosis when a student, the patient was physically sound, except for a slight arterio-sclerosis. At the operation the gall-bladder was found small and adherent to the transverse colon. Following the cholecystostomy there was hæmatemesis several times during the first twenty-four hours, continuing for three days. The hæmorrhage, however, was controlled by washing the stomach with iced water. In the case of the 43-year-old woman who had had several biliary colics during the last year, the operation disclosed dense adhesions between the intestine, omentum, stomach, and gall-bladder. The gall-bladder was shrunken and empty, with a stone in the mouth of the cystic duct. On the following day there was a troublesome hæmatemesis, which continued for three days, and was controlled in the usual manner.

Robson and Moynihan report a case of carcinoma of the biliary ducts in which there was a pronounced hæmatemesis on the day following a cholecystostomy performed under local anæsthesia. Death occurred on the third day, and the autopsy disclosed no peritonitis or change in the stomach.

Purves, after a partial resection of the omentum and an operation on the gall-bladder for stone, in a woman of 56 years of age, who had had repeated attacks of biliary colic for five years, had a similar experience, but in his case the hæmorrhages were so severe as to lead to death after seven days. The slight elevation of temperature and the rapid pulse pointed to a general infection having its origin in the gall-bladder.

Landow performed cholecystostomy in a woman, 45 years of age, who had suffered from biliary colic. Adhesions of the omentum to the gall-bladder were found at the operation. There was hæmatemesis on the second and third days, and afterwards uneventful recovery

None of these cases showed hæmorrhages from the bowels, but it may easily be seen from what follows that the same condition which would bring about hæmorrhage from the stomach could as well cause bleeding from the mucous membrane of the bowel. I append a number of cases of hæmatemesis following appendectomy. From these it may be learned that my own experience parallels that of the German rather than the French reports, as to the fatality of this complication.

Von Eiselsberg reports four cases of hæmorrhage following the first or second day after the operation, after a typical appendectomy, all of which disappeared under gastric lavage. In no case was there any fever, and in one of the cases removal of the gauze drain brought the hæmorrhage to a standstill; in another the removal of a few sutures achieved the same result.

Dieulafoy's reports do not show such favorable results in hæmorrhage from the stomach following appendectomy. He reports ten cases, in eight of which this complication was followed by death within the first three or four days. His cases of appendicitis were perhaps more severe than those reported by the other authors cited, and it is perhaps due to this fact that the condition for embolism was more favorable in that class of cases than in ordinary simple appendicitis.

Mintz reports a case of a man of forty years, suffering from gangrenous appendicitis. The night following the operation hæmatemesis began and continued for four days, when paralyses and muscular twitchings developed. Death ensued on the seventh day. Post-mortem disclosed acute yellow atrophy of the liver, erosion on the mucous surface of the duodenum, and stasis of the intestinal vein.

Charlot reports three fatal cases, one in a child, eight years old, in which there was appendicitis complicated by peritonitis with hæmatemesis directly after the operation, and death; a child of nine, with a similar condition; and a third child, 8½ years old, who had suffered for three weeks with appendicitis, with hæmatemesis before and after the operation. In all of these cases the author was fortunate enough to get an autopsy, which disclosed punctiform hæmorrhages in the mucous membrane of the stomach.

Lucas Championniere reports a case of gangrenous appendicitis, complicated by abortion, with alarming hæmorrhages after two days, but in his case followed by recovery; whereas Guyot and Charles report a case with hæmatemesis on the day following operation, with death in a few hours from hæmorrhage, in which the autopsy disclosed ecchymoses.

From these cases we learn that the danger of stomach hæmorrhage from appendicitis seems directly dependent upon the condition of the appendix, and is much more likely to occur if the operation is delayed too long, because of the greater liability to general sepsis.

TREATMENT AND PROPHYLAXIS

From the foregoing, it can be readily seen that we are confronted with a serious danger which cannot be foreseen in many cases of gall-bladder and appendiceal diseases, and that especially in older persons and the very young we should take great precautions to prevent a fatal outcome. To begin with, we should carefully reject all cases in which there is any suspicion of old ulceration of the stomach or duodenum, for fear that in handling the tissues during the operation we might start new hæmorrhages. Such cases should not be operated on until careful preliminary medical treatment has practically precluded the danger of such a serious complication. Again, when there is concomitant cardiovascular disease or nephritis, the operation should not be done until the patient has first had careful medical treatment. Operation in such cases should not be an operation of election, but of compulsion. It is surprising how many patients may be bridged over severe gall-bladder attacks by careful, patient medical treatment, for, as we have attempted to expound, the risk following operations in the cases instanced is in many cases greater than in following a conservative policy. It is not our province here to go deeply into the indications for operation in cases of cholecystitis, but if the decision has once been made to intervene surgically, there are certain precautions to be followed which the foregoing facts amply warrant. First and foremost, the patient should have his gastro-intestinal tract carefully prepared for days in advance of the operation by non-irritating enemas and cathartics, and semi-

solid bland diet. Next, if there is arteriosclerosis, with its attending complications, iodides in small doses may be given for weeks in advance with great further advantage to the patient, and so on through all of the indications for the various accidents that may arise. A few days preceding the operation calcium chloride, either in enemas or by mouth, should be given in repeated doses.

Laughing gas mixed with oxygen should be the anæsthetic of choice; the operation should be terminated as quickly as feasible, and the attention of the surgeon confined as nearly as possible to the site to be operated on, after pylorus and pancreas have been carefully explored. There should be as little handling and tearing of tissues as is consistent with the needs of the case, and no unnecessary manual exploration of other organs, if the diagnosis is clear. After the termination of the operation, the patient should be slightly elevated as soon as his strength allows it, and had best receive a dose of morphine, or, better still, stypticin, unless there are renal contraindications. Food should be withheld for some days, and the nourishment confined to easily assimilable fluids after one day or more of complete starvation, depending on the strength of the individual. Milk should be eschewed, on account of its peculiar liability to cause gas. If, in spite of all of our precautions, hæmorrhage intervenes, we should begin with gastric lavage and small doses of such styptics as stypticin and morphine hypodermically. It is often of advantage to add a small amount of ferric chloride to the water used in washing out the stomach, and it should be gradually cooled. In one of my cases I used iced ferric chloride solution with seeming benefit to the patient. If there is collapse from loss of blood or shock, it is of great advantage to add calcium chloride either to the salt infusion or to the constant irrigation, as the case may be. I have always feared to use gelatine hypodermically, even when in the form now made by Merck, but confine its use to administration by mouth. Ergot in any of its forms I have never found of benefit in combating this form of hæmorrhage, and strychnine, adrenalin, and other heart tonics are distinctly dangerous in cases of bleeding, especially adrenalin, which notably raises the arterial tension. Best of all I have found stypticin, which may be given repeatedly in three-fourths grain doses without harm.

In conclusion, we may say that the following are probably the causative factors in post-operative bleeding.

1. Age. The danger increases gradually in patients sixty years old and above, owing to the rigid blood vessels; and also in the very young, especially in cases of gangrenous appendicitis.

2. Previous history. Latent gastric and duodenal ulcerations which are lighted up during the course of the operation.

3. Traumatism of stomach, duodenum, and bowels incident to handling during operation.

4. Anæmia and marasmus.

5. Infection, local and general.

6. Heightened blood pressure in coexisting heart and lung diseases.

7. Thrombosis and embolism of gastric and intestinal vessels.

8. Atrophy and amyloid degeneration.

9. Gastroduodenitis, leading to hyperæmia, pressure necrosis, and diapadesis.

10. Nervous disturbances causing anæmia or hyperæmia, with subsequent necrosis and ulceration.

11. Post-operative vomiting, which is a very important factor in the lighting up of old ulcerations.

12. Traumata to tongue, incident to the narcosis.

13. Ligating of omental and mesenteric vessels causing direct and retrograde embolism or thrombosis, whether infected or not from the primary focus.

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ACUTE OSTEOMYELITIS

By F. G. DYAS, M. D., Chicago, Illinois

A CONSIDERATION of the subject of acute osteomyelitis necessarily involves a study of acute periostitis and ostitis, because of the intimate association of the pathologic changes occurring in each.

The condition was first described and put upon a scientific pathologic basis by Chassaignac.

It is of especial interest because of 1. the comparatively small amount of literature bearing upon this subject; 2. because of the necessity of making an early correct diagnosis and the frequent disastrous consequences following a failure to appreciate the condition in its incipiency; 3. because of the relief to the patient, when the tension of the abscess cavity is relieved; and 4. because of the protean character of the certain complications following neglected cases of acute osteomyelitis.

DEFINITION

Acute infectious osteomyelitis may be regarded as a pyæmia manifested clinically, by a local suppuration of the bone and periosteum and by constitutional symptoms, due to the presence of the infecting organisms or their products in the blood; and, pathologically, by an infection of the periosteum or medulla by pathogenic microörganisms, resulting in a more or less complete destruction of the affected bone.

ETIOLOGY

1. *Anatomic predisposing conditions.* From an anatomic standpoint, there are certain conditions which predispose to the arrest and localization of infective material in the bone. By injection of the blood-vessels of bone with a solution of turpentine and mercury, Lexer was able to make skiagrams demonstrating the arterial system of the long bones, which was found to consist of three main divisions: 1. One set of branches from the nutrient artery of the bone which enter the medulla and supply it as far as the metaphysis, viz., the area of spongy bone adjacent to the epiphysis; 2. The vessels of the metaphysis, numerous small twigs branching from the vessels of the joint capsule and entering the cortex near the junction of the osseous and the cartilaginous areas; 3. The epiphyseal branches.

The metaphysis, or area adjacent to the epiphysis, is composed of spongy bone, areolar tissue, and embryonal blood-vessels of irregular and narrow lumen, prone to thrombosis and easily arresting foreign material carried by the circulating blood; whence the importance of trauma to a tissue so naturally fitted to undergo pathologic change. The nutrition of the part is poor, especially in the long bones of growing persons. During the period of most active growth, i. e., up to 20 years of age, the epiphysis and adjacent tissues retain, to some extent, their embryonal character. While the small, flat bones are sometimes involved in the infective process, it is usually the result of metastatic infection and many bones are involved simultaneously, or in quick succession, the patient presenting the picture of a severe general septic intoxication and frequently rapidly passing into the status typhosus, with a fatal termination. In single osseous infections, on the contrary, the long hollow bones are more commonly attacked, because of their poorer vitality and larger amount of embryonal tissue. Statistically the long bones are involved 12 times more frequently than the small, flat bones.

2. *Trauma.* The importance of injury to the bone as an exciting factor in the production of acute osteomyelitis cannot be overestimated. The trauma may have been so slight as to have been forgotten by the patient, or, at least, not ascribed by him as initiating his symptoms, but, upon careful questioning, especially where the long bones of the extremities have been involved, a history of trauma can be obtained in the large majority of cases.

The degree of injury may vary through all gradations, from a simple contusion without breaking of the skin to a compound fracture or amputation stump, or the osteomyelitis may follow long-continued mild irritation of the

bone, as by the presence of a foreign body aseptically retained in the bone itself or the contiguous soft tissues. In the case of open wounds, the infective material is usually introduced from without, in contradistinction to the subcutaneous wounds in which the infection is of hæmatogenous origin. Crushing injuries favor the production of an osteomyelitis, because of the traumatizing of the larger vessels and the resulting ischemic necrosis; however, a blunt trauma, as a blow or a kick, falling upon an extremity, slipping or wrenching is by far the commonest cause.

3. *Exposure to cold.* This has long been regarded as the causative factor in the onset of many of the acute diseases, but of none of these can it more certainly be traced as the starting point of an infection than of acute osteomyelitis. Prolonged moderate chilling, as swimming in water at a temperature between 65° and 70° F., or the wearing of damp clothing after a wetting, rather than exposure to extremes of cold, seems to predispose.

4. *As a complication or sequence of acute infectious diseases.* Acute osteomyelitis may be caused by any acute infectious disease, but is especially common in typhoid, pneumonia, scarlatina, measles, variola, diphtheria, pyæmia, and puerperal septicæmia. The fœtus has been infected from the blood of a mother suffering from rheumatism and acute ulcerative endocarditis (Elingart). The new-born child has suffered from acute osteomyelitis, the result of infection of the umbilical cord (D'Astros). Acute infectious osteomyelitis of the tibia has frequently occurred as the result of an infected abrasion of the foot, following the wearing of an ill-fitting shoe, and it is sometimes difficult to trace the connection between the primary focus and the bone infection, as the primary lesion is often healed before the secondary appears.

5. *Age.* As the disease occurs during the period of most active bone proliferation and in the embryonal tissue of the metaphysis, we find the greatest incidence between the ages of 8 and 17 years. Only 3 per cent of cases occur after ossification is complete (Trendel).

It is very rare in infants and in the aged.

6. *Sex.* Males are attacked with greater frequency than females in the proportion of three to one (v. Bruns), probably because of their greater exposure to trauma.

7. *Epidemics* have occurred in certain localities, both of a primary hæmatogenous form, e. g., traumatic, and of an osteomyelitis secondary to acute infectious disease. This may be analogous to the epidemic appendicitis.

BACTERIOLOGY

The bacteriological consideration of acute osteomyelitis is most interesting. In the hæmatogenous type, in a large number of cases the infectious material reaches the blood stream during the course of some of the acute infectious diseases, or from some localized suppurative process, as in furunculosis; but, in addition to these, there are certain cases in which no history of such previous condition can be obtained.

The infecting organism may enter the blood through small abrasions of the— 1. Skin, superficial burns, dermatological lesions, especially eczema, furunculosis, phlegmon and erysipelas; 2. Puerperal septicæmia, caused by manual removal of the placenta, has been followed by acute osteomyelites of the humerus (Trendel); 3. Angina and catarrhal bronchitis and enteritis in children (v. Bruns).

In v. Bruns' clinic at Tübingen, Trendel found, upon an analysis of 78 cases of acute osteomyelitis, the incidence of the infecting microorganisms to be as follows; Staphylococcus pyogenes aureus 76; streptococcus 5; mixed infection, staphylococcus and streptococcus, 5 times; diplococcus lanceolatus of Fräenkel 1.

In one case of osteomyelitis of the os innominatum following typhoid fever, a culture made from the pus proved sterile.

It is interesting to note in this connection, that in infections of the bone, as elsewhere, each type of pathologic microörganism preserves its individuality and plays its rôle as characteristically in the osseous as in the soft tissues. In infections by the bacillus typhosus no acute purulent condition is produced, unless a mixed infection occurs at the point of inflammation, when the typhoid abscess which, when not contaminated, takes on many of the clinical characteristics of a cold abscess, becomes the typical process of acute infective osteo-

myelitis. The typhoid form of osteomyelitis tends to undergo resorption and encapsulation or to become chronic, when not contaminated by other organisms. Infections with the staphylococcus aureus occur in the cases of moderate severity, while the streptococcus produces a rapid necrosis of the bone and is frequently fatal.

PATHOLOGY

The simplest form of acute osteomyelitis occurs in every fracture, as evidenced by the cellular proliferation, extravasation of blood, and callus formation at the point of injury. In acute infectious osteomyelitis, the introduction and retention of pathogenic microorganisms occur: 1. Either at the site of trauma to the bone or periosteum in open wounds; 2. As a metastatic focus from suppurative processes elsewhere, or as a sequela of some acute disease; 3. or, Finally, as a hæmatogenous infection, the point of localization being determined by a previous trauma or by the arrest and proliferation of the pathogenic flora in the terminal capillary loops of the metaphysis of growing bone. The shafts of long bones are most commonly affected when the focus is single, especially, the shafts of the femur, tibia, and humerus; while in metastatic foci, the flat bones are more often involved. The percentage of involvement of the long bones, as observed in 440 cases in v. Bruns' clinic, was as follows:

Femur	38.5	Radius	5.1
Tibia	38.5	Fibula	3.4
Humerus	11.1	Ulna	3.4

(Trendel, Beiträge zur Kenntniss der acuten infectioesen Osteomyelitis.— Beiträge z. klin. Chir. 1901 4, p. 607.)

The localization of osteomyelitis on the right and left half of the body shows no difference. In an analysis of 1,252 cases, 632 were on the right side, against 620 on the left side (Trendel).

LOCALIZATION IN THE DIFFERENT BONES OF THE SKELETON

I. The long hollow bones. Reiss (Arch. f. klin. Chir., vol. lxii), in von Bergmann's clinic, reports the following distribution in 90 cases:

31 times femur	5 times fibula
30 times tibia	4 times radius
19 times humerus	1 time ulna

Kluck (Diss. Greifswald, 1890), from the clinic of Greifswald, reports 65 cases as follows:

17 times femur	3 times fibula
30 times tibia	3 times radius
9 times humerus.	3 times ulna

Funke reports as follows upon 577 cases:

276 times femur	21 times fibula
226 times tibia	46 times radius
	8 times ulna

The statistics of the surgical clinic at Heidelberg from, 1857 to 1902, show the following distribution: 121 femur, 101 tibia, 14 humerus, 6 ulna, 4 radius, 4 fibula.

Statistics of older authors show the same overwhelming majority of cases of osteomyelitis of the femur and the tibia (Luecke, von Volkmann, Helferich).

Trendel found in von Bruns' clinic in Tübingen, 1,110 cases of osteomyelitis of the long hollow bones as follows:—

508 times femur or 45.8 per cent.
386 times tibia or 34.8 per cent.
102 times humerus or 9.2 per cent.
43 times radius or 3.9 per cent.
36 times fibula or 3.2 per cent.
35 times ulna or 3.2 per cent.

II. *Short and flat bones.* Sick, of Hamburg, (Centralbl, f. klin. Chir., 1896, p. 798), reports inside of 13 years a collection of 177 cases of acute osteomyelitis, where the short and flat bones were affected 53 times.

Fröhner's statistics of von Bruns' clinic show involvement of 470 long bones against 34 short and flat bones; of the latter, 11 cases were confined to only one bone, and in 23 the long bones were affected at the same time.

Statistics of the clinic at Heidelberg show a proportion of involvement between the long, and short, flat bones of 7.5 to 1.

Funke finds with 588 long bones, 30 flat and short bones affected, equal to a proportion of about 20 to 1.

The entire material of Trendel shows the following conditions:

1,110 long bones against 169 short and flat bones, a proportion of 6.6 to 1.

102 times, short and flat bones alone are affected; 3 times, 2 short bones at the same time; 62 cases of long and short flat bones at

the same time. The incidence of involvement of the flat bones is as follows:

Pelvis	28	16.6%
Lower jaw	24	14.2%
Clavicula	24	14.2%
Costæ	11	6.5%
Scapula	11	6.5%
Vertebræ	8	4.8%
Upper jaw	4	2.4%
Os parietale	3	1.8%
Os occipitis	2	1.2%
	115	

Only two cases of acute infectious osteomyelitis of the patella have been reported[1] in contradistinction to the much more frequent involvement of the patella in tuberculous infections. Murphy's recent article on tuberculosis of the patella, in SURGERY, GYNECOLOGY AND OBSTETRICS, vol. vi, No. 3, reviews the literature of patellar tuberculosis fully.

A. Riga, in von Bergmann's clinic (in an article entitled Erfahrungen über Becken Osteomyelitis — Archiv. für clinische Chirurgie, 1906, vol. lxxxi, p. 504), says that, up to 1881, ten cases of osteomyelitis of the pelvis were reported in detail, all ending in death.

Fröhner and Trendel (Beiträge für clin. Chir., vol. xli) report 53 cases, mostly fatal. The prognosis in pelvic osteomyelitis is always poor, because of the extensive involvement in the spongy tissue of the bone and the difficulty of performing a radical operation.

PATHOGENESIS

The infection may begin in the periosteum or medulla, rarely in the spongy tissue or compact bone.

a. In the periosteum, the process begins as a hyperæmia and thickening, followed by a purulent infiltration beneath and around the periosteum, burrowing into the soft tissues and elevating the œdematous and necrotic membrane from the bone. In severe cases, there is complete necrosis of the shaft of the bone corresponding to the area of periosteal involvement, while in less virulent infections the process may subside with the production of a simple osteoporosis.

[1]Jahresbericht der Heidelberger Klinisch, 1898; Beiträge Klinisch, Chir., vol. xxvi.

The tension of the infective material beneath the thickened periosteum may cause it to enter the Haversian canals and infect the medullary cavity, producing a rapid necrosis of the entire bone.

In other cases, the purulent material reaches the surface and produces a discharging sinus, or it may travel along the muscular and fascial planes and reach the periarticular tissues, finally causing a septic arthritis. When a limited portion of the periosteum is destroyed, necrosis of the underlying bone, corresponding to the periosteal involvement, occurs. In the process of bone regeneration, which follows, the necrotic bone is not usually absorbed, but is separated from the healthier tissue and remains as a foreign body or sequestrum, frequently retaining in its substance for many years pathogenic microörganisms, which may remain quiescent for long periods of time, only to break out again, in the same or different bones, after a slight trauma or other predisposing influence. The germinal layer of the periosteum produces an enveloping sheath of bone, the involucrum, which surrounds the sequestrum, more or less completely, depending upon the condition of the periosteum. The involucrum is frequently honeycombed by sinuses leading from the invested sequestrum to the surface.

b. In the medullary cavity the introduction of infection is followed by hyperæmia, cellular proliferation, and the exudation of a serous, hæmorrhagic, or purulent material which forms grayish-yellow foci in the marrow, resulting in various-sized abscesses, which may remain discrete or coalesce, converting the medullary space into an osseous pus cavity. The tension under which the retained purulent material is confined, forces the infection into the Haversian canals and bone spaces from which it communicates with the periosteum.

The infectious process usually commences in the metaphysis, viz., that portion of the shaft adjacent to the epiphysis, and most commonly attacks the lower end of the femur and the upper ends of the tibia and humerus (Kocher). In the differentiation of tuberculous osteomyelitis, it is interesting to note the fact that the tuberculous affection usually begins in that portion of the bone between the epiphyseal

line and the articular surface, in contrast to acute infectious osteomyelitis in which the infective process usually begins in the shaft adjacent to the epiphysis.

Involvement of the epiphysis or end of the diaphysis may result in necrosis of the intermediary cartilage and epiphyseolysis, with or without involvement of the adjacent joint cavity. Destruction of the epiphyseal cartilage, which is the center of bone proliferation, prevents the further growth of the bone in a longitudinal direction. Ossification of the intermediary cartilage occurs about the 20th year, after which epiphyseolysis is rare.

In cases of low virulence or those in which the tension within the medulla has been relieved by an opening in the shaft of the bone, the destructive process confines itself to the medullar cavity, producing a necrosis of the internal layers of the bone without involvement of the periosteum or epiphyseal cartilage.

In the rarer cases of osteomyelitis albuminosa, described first by Poncet and Ollier and later by von Bergmann, there is a profuse subperiosteal collection of synovial-like fluid, causing the clinical manifestations of pain, swelling, and fever. The process occasionally attacks the medulla in the region of the metaphysis. There is no pus formation and von Bergmann considers it to be the result of the action of attenuated pus cocci or a manifestation of syphilis or tuberculosis. The condition tends to become chronic with sinus formation and bone necrosis.

The process of repair in acute infective osteomyelitis is essentially the same as the primary growth of bone, or as the healing of fractures modified by the presence of an acute infective process, and consists, anatomically, in the production of a medullary and periosteal callus and, histologically, in an ossifying periostitis and osteomyelitis.

The period of incubation lasts from a few hours to a few days. This, of course, can be reckoned only in those cases where there is a history of trauma, and lasts from the time of injury to the onset of symptoms. Trendel speaks of the frequent onset of symptoms in children, two or three hours after going to bed, on the night following the injury.

Theim proposed a law setting 14 days after injury as the extreme limit of time during which an acute infectious osteomyelitis may occur (Trendel). In the majority of cases, the onset of symptoms occurs within 24 or 48 hours after the initial injury or chilling.

SYMPTOMS

These vary with the location and extent of the process and the variety and virulence of the infecting organism. In severe forms, the local manifestations of pyæmia are rapidly overshadowed by the constitutional symptoms resulting from the bacteræmia and toxæmia.

1. *Pain* is the dominant symptom. It appears first, and, as a rule, lasts throughout the disease, increasing in intensity until the tension of the infective material confined in the medullary cavity, or beneath the periosteum, to which the pain is due, is relieved by incision and removal of a portion of the osseous wall of the shaft or by complete necrosis of the part. Frequently it is diagnosed as rheumatic, but it is of greater intensity and involves the metaphysis rather than the articular surfaces. It radiates along the bony shafts, being referred to the knee in involvement of the femur or tibia, or to the elbow in infections of the humerus, and is worse upon movement of the part. In children it frequently commences during the early hours of the night, and the child awakens screaming with pain.

2. *Chill.* This sometimes precedes the pain, in time but not in importance. It comes on abruptly and is due to the rapid absorption of the infecting microörganisms and their products into the circulating blood. The high tension under which this rapidly increasing pathogenic flora is held, within the unyielding confines of the bone, favors septic embolism and multiple foci of suppuration, the invasion of fresh areas being manifested by renewed vigors. The initial rigor ir rarely absent, while the occurrence of secondary chills is dependent upon the further absorption of toxic material.

3. *Fever*, of a high, angular, septic ype, is always present. It will be found during the chill and rapidly rises to 103° or more. It is caused by the local and general pyæmia, and continues until the source of infection is removed.

Accompanying the fever are all the signs of an acute general intoxication, viz., flushing of the skin; dry, coated tongue; scanty, albuminous urine; headaches, and, frequently, nausea and vomiting. Slight remissions of the fever occur at irregular intervals, frequently during the morning hours, but the temperature rapidly rises again, often accompanied by secondary chills.

4. *The blood* shows an early, high, polymorphonuclear leucocytosis. Cultures made from the blood within 24 hours after the initial chill, frequently show the infecting organism; and these may be confirmed by cultures taken from the abscess in the bone or periosteum, or from an initial focus elsewhere. Marked anæmia is common and frequently resembles the pernicious type (Edwards).

5. *Diarrhœa* of a septic sype, with 5 to 10 dark movements daily, is common, especially in children.

6. *Splenic enlargement.* This may be due to the general pyæmia or to infarction by the infecting organism. The spleen is palpable clinically in a large number of cases and is frequently tender to the touch.

7. *Skin.* Scarlatiniform, morbilliform and urticarial eruptions may occur, resembling antitoxin rashes. Herpetic, vesicular, and pustular eruptions occasionally occur. Ecchymosis occurs in 50 per cent of fatal cases (Edwards).

8. *Nervous system.* In the severe, rapidly fatal cases, the nervous symptoms may overshadow the local manifestations. Convulsions, delirium, coma, and the status typhosus may occur. Occasionally, meningitic symptoms appear.

9. *Heart and arteries.* Myocardial weakness, ulcerative endocarditis, and vasomotor paralysis may occur. The pulse is weak, rapid, and often irregular.

The local findings are as follows:

1. Swelling is noticed during the first 24 hours after the initial pain and chill, in superficial bones and in thin subjects. It is fusiform in shape and may extend in a longitudinal direction for a distance corresponding to about one-half or two-thirds the length of the bone, but does not encircle the circumference of the shaft. When the periosteum is destroyed and the pus burrows along the soft tissues to the periarticular structures and into the joint cavity itself, the whole extremity may become swollen and the picture is one of a spreading infection of the entire limb.

2. Redness of the overlying skin, due to the local inflammation itself, or to vasomotor paralysis from the absorption of the products of infection, occurs.

3. Tenderness over the affected area. This is exquisite and is due to the tension of the infective material, the patient being unable to bear the slightest pressure. Movement of the adjacent joint is painful, although there may be no articular involvement.

4. Oedema and fluctuation of the skin and subcutaneous tissues occur when the purulent material invades the soft parts. Later the pus may burst through the skin and produce a discharging sinus.

5. Loss of function of the part is always present and may be due to (a) the intense pain; (b) involvement of the adjacent joint cavity; (c) necrosis of the shaft of the bone; (d) epiphyseolysis; (e) spontaneous fracture; (f) sub-luxation of the head of the bone.

6. Deformity is caused by the swelling of the soft tissues and the pathologic changes in the bone.

7. False point of motion occurs in spontaneous fracture and epiphyseolysis.

8. The X-ray is of advantage in confirming the above changes and also for showing osteoporosis, sequestra, and abscess cavities.

9. Later findings are angulation, axial rotation of the shaft of a bone on its head, following epiphyseolysis, hyerpostosis, shortening, limitation of motion, and anchylosis consequent to joint involvement, muscular contractions, and atrophy.

CLINICAL COURSE

1. *Severe form.* In this type, the pyæmia and constitutional symptoms predominate. The onset is sudden, with acute pain in the affected limb, severe rigor, high fever, rapid, weak, irregular pulse, diarrhœa, and delirium or convulsions in children. The patient passes rapidly into a typhoid state and death occurs within a few hours. While there may be acute destruction of the bone and adjacent joint in this type, the severe general septic condition overshadows the local manifestations.

2. *Mild form.* Here, the local and systemic symptoms are slight, and usually subside upon evacuating the abscess.

3. *Usual or moderate form.* Here, the local manifestations predominate, although the onset may be accompanied by a severe general reaction. This type of bone infection tends to become chronic and is frequently followed by sequestrum formation, hyperostosis, and bony deformity; however, the area of medullary or periosteal involvement is no index of the severity of the symptoms or the virulence of the pyæmia.

TERMINATIONS AND COMPLICATIONS

1. *Complete recovery* is possible without destruction of the bone in cases of mild infection, even without treatment, but usually early drainage is necessary for a preservation of the bone. Where the infective process is confined to the periosteum, simple incision is sufficient, but it is not always possible to determine in a given case whether or not the medulla has been invaded, and therefore a small hole should be drilled through the shaft into the medullary cavity to relieve the tension of infective microorganisms that may be present.

2. *Sequestrum formation* furnishes one of the most interesting, and, at the same time, one of the most unmanageable features of acute infective osteomyelitis, because of the tendency of these bodies to retard complete bone regeneration, and to furnish a culture medium for attenuated, osteomyelitic cocci, which, after long periods of time, may light up renewed infection in the same bone, or a fresh inflammation in others.

The irritation produced by the long-continued presence of a sequestrum may cause a hyperostosis of the involucrum which frequently is greatly weakened by sinus formation, due to the escape of pathogenic organisms from the invested sequestrum. This weakening of the bone predisposes to spontaneous or pathologic fractures. The relative frequency of spontaneous fractures as complications in acute infective osteomyelitis, may be estimated from the fact that Trendal found 23 instances amongst 1,058 cases, or 2.17 per cent. From von Bergmann's clinic, Funcke reports two cases of spontaneous fracture in 46 instances of osteomyelitis of the humerus, 4.3 per cent; and 4 cases of spontaneous fracture in 276 cases of femoral osteomyelitis, 1.4 per cent. Deformities, such as angulation, shortening or axial rotation, especially of the femur, are favored by sequestrum formation.

Removal of the sequestrum is almost always necessary for the complete repair of the bone. Occasionally, it is extruded through the soft tissues, but more commonly it must be removed by surgical measures, because of the surrounding bony involucrum.

3. *Metastatic abscess formation and pyæmia.* Pyæmia may be the cause or the result of an acute infectious osteomyelitis, and is due to the arrest of septic emboli, not only in the bones, but in the soft tissues. Acute pulmonary diseases, as pneumonia and pleurisy, are frequently observed as accompaniments of acute osteomyelitis (Trendel).

4. *Subsidence of the acute symptoms* followed by chronic suppuration and general amyloidosis — amyloid degeneration of the kidneys is especially apt to occur. Acute suppurative nephritis was observed 8 times in 1,058 cases (Trendel).

5. *Joint affections*, as septic arthritis, are frequently followed by limited motion, or anchylosis, and occur in the severe, rapidly spreading forms in which the epiphyseal cartilage is destroyed and the joint cavity invaded.

6. *Epiphyseolysis.* Loosening of the epiphysis may be followed by the later union in a normal position, but deformity ensues because of the destruction of the intermediary cartilage and the inability of the bone to increase in length.

Diagnosis. The history of the case with the general and local manifestations, as given above, are usually sufficient.

DIFFERENTIAL DIAGNOSIS

1. *Acute articular rheumatism*, because of its more common occurrence, is the most important condition to differentiate. It is recognized by the successive and fugitive involvement of the joints, rather than the shafts of long bones, the absolute absence of suppuration, the drenching sweats, the rapid, early anæmia, and the invariable response to salicylate treatment. The arthritis is never septic and is never fol-

lowed by limitation of motion or anchylosis. There is no bacteriæmia, neither is there a local or a general pyæmia, yet acute infectious osteomyelitis is more frequently confounded with acute articular rheumatism than with any other condition. The disastrous results of a failure to differentiate these conditions because of the lack of appropriate treatment have been mentioned. Trauma is never an exciting cause.

2. *Osseous tuberculosis* comes on insidiously, usually from 4 to 6 weeks following trauma. The history of injury may be hard to elicit, because of the length of time before the onset of the local manifestations and because of the frequently insignificant character of the injury. The pain is dull, rarely of the severe type seen in acute infectious osteomyelitis. In the limb, the process is first evidenced by a limp, or fatigue upon slight exertion. In contrast to the severe constitutional symptoms of pyæmia, the systemic disturbance in tuberculosis is slight. Tuberculosis elsewhere may co-exist, as the glandular form in children and the pulmonary form in adults.

3. In *septic arthritis*, the process begins in the joint itself. The constitutional symptoms may resemble osteomyelitis, but the location of the process differentiates it from infection of the shaft.

4. *Syphilis of the bones* is characterized by its slow onset, chronicity, frequently painless swelling, history of syphilis, and the cutaneous, glandular, mucous, and visceral evidence of the disease elsewhere, and its response to mercury and iodides.

TREATMENT

This is always surgical, and consists of relief of the tension and evacuation of the infective material as soon as the diagnosis is made. The writer saw one case of acute osteomyelitis of the tibia in which the patient was admitted to the hospital on the night of the attack, but operation was delayed until the following afternoon at 4, at which time it was necessary to do an amputation of the thigh. The medullary cavity should be opened, and, if necrotic tissue is found, the bone should be thoroughly chiseled away, leaving the cortex surrounded by periosteum. Disinfection of the cavity by solutions of carbolic acid, bichloride of mercury, or formalin is thoroughly carried out.

A series of experiments upon the action of a 2 per cent formalin in glycerin solution upon dogs, was carried on by the writer under the direction of Dr. Murphy and the following was noted:

1. Injection of 1 dram of the solution into the femoral vein produced a powerful stimulation without any toxic effects.

2. Injection of a like amount into normal joints produced a hyperæmia and round-cell infiltration.

2. Injection of the joints with cultures of the staphylococcus aureus and pneumococcus, and immediately followed by injection into the joint cavity of 1 dram of the solution; in no case of the eight joints so treated did a septic arthritis ensue. Acting upon the evidence thus obtained, and upon the results obtained clinically in a number of cases, Dr. Murphy modified the von Mossetig Moorhof plug, consisting of wax, iodoform, and carbolic acid, used for filling the osteomyelitic cavity after operation, to the following:

Glycerin, 300.
Gelatin, thoroughly sterilized, 300.
Aqua, 400.

Formalin (40 per cent), 20 parts of which is added immediately before using.

The liquified mass is poured into the cavity and solidifies at body temperature. The skin flaps are sutured over this mass. The results obtained by this method of treating the osteomyelitic cavity have been most satisfactory. The further treatment consists in frequent dressing, removal of sequestra and spiculæ of bone, orthopedic measures to correct and prevent deformity, and constitutional treatment, consisting of extract of thyroid and tonics.

REPORT OF A CASE OF GASTRIC TETANY, OPERATION AND RECOVERY

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GASTRIC tetany is a grave complication of obstruction of the pylorus characterized by attacks of bilateral tonic muscular contractures beginning in the extremities and extending to the face, body and larynx. In this definition we wish to emphasize the obstruction of the pylorus as the anatomical cause for this particular variety of tetany. We deem this necessary, first, on account of the incorrect definition prevalent in the current literature, second, because this anatomical condition is one which can be relieved by surgical means, and third, because we wish to accentuate this form of treatment which will place the majority of these cases, formerly considered fatal, among the curable diseases. Until recently gastric tetany has been vaguely defined as tetaniform convulsions associated with dilatation or hypersecretion of the stomach. An analysis of the cases up to this time, as will be shown later, demonstrates beyond a doubt that a mechanical obstruction of the pylorus is the initial and causative lesion. The dilatation of the stomach, which is present in this condition, is as much a sequel of this obstruction as is the tetany itself.

This variety of tetany was first described in 1869 by Kussmaul in his classical publication on "The Treatment of Dilatation of the Stomach by a New Method — The Stomach-Pump." In this work he describes a case of dilatation of the stomach in which severe attacks of tonic convulsions occurred. These convulsions began in the hands and feet and extended up the extremities to the face and body. The local spasms in the face and arms were reproducible by mechanical stimulus. He discovered that stomach lavage would prevent many of these attacks as well as relieve the accompanying gastric symptoms. The following case, bearing such a remarkable resemblance to this first case reported, testified to the great value of permanently recording unusual clinical data in the literature.

REPORT OF A CASE

Mrs. M. C., age 48, housewife.

History. Family: Father died of paralysis commencing in the fingers (?) Paralysis on the father's side of the family. Past: Nervous prostration six years ago. Chronic ear trouble, earache, discharge, etc., intermittently all her life. Backache associated sometimes with polyuria which seemed to relieve the pain. Œdema of the ankles when a girl. Personal: Mother of four healthy children. One abortion without known cause at the third month. Menopause began three years ago. Scanty periods occur yet every four or six months. Last one a week ago. Occasional hot flush, and has been more nervous during this time. Present: Duration one and one-half years. The onset was gradual with the formation of gas in the stomach causing belching and occasional vomiting. These gastric symptoms were present only after certain diet (potatoes, beans, etc.) and continued one or two months without causing any other marked discomfort. At the end of that time patient began to have a "heavy feeling" in the upper part of her abdomen. The first convulsion occurred about three months after the onset. After eating some food "which did not agree with her" she had a feeling of distress described as "distension and discomfort" in her abdomen. This was soon followed by a very severe convulsion which began with a "feeling of stiffness, folding and clinching of the hands, and a drawing down of the toes"; extending rapidly to the muscles of the extremities and involving the muscles of the body and trunk but not the larynx. These spasms were very painful and lasted for three or four hours. At the end of this time the patient vomited, the vomitus containing a small amount of blood. During the seizure she has been given a number of hypodermic injections of morphine without relief. After the vomiting the tonic contraction of the muscles gradually relaxed but the patient was left in a collapsed condition for over a day. Following this, attacks varying in severity recurred a number of times immediately after eating so that the patient soon began to associate these convulsions with errors of diet. This led her physician to use stomach lavage

as the treatment for these attacks. Since this was adopted a year ago, the patient has been lavaging her stomach as frequently as eight and ten times a day. Whenever she would have any abdominal distress accompanied by numbness or stiffness of the fingers she would immediately introduce the stomach tube and lavage her stomach or cause emesis. This has served to modify the severity and prevent a number of attacks of convulsions. She has, however, had an occasional attack of a very severe nature, the last one lasting two hours, occurring three weeks previous to the date of this examination. Her diet has consisted of milk, buttermilk, and crackers exclusively for one year The appetite has been good but she has been afraid to eat anything except the above on account of being fearful of bringing on these attacks. No history of severe abdominal pain, hæmatemesis, jaundice, or symptoms referable to other organs, except that given above. She lost 50 pounds during the last year.

Examination. General: development and nutrition poor, absence of adipose tissue. Color: mucous membrane pale; skin sub-icteric; lips crimson; cheeks flushed; hands and toes slightly cyanosed. Pulse 112, medium volume, decreased tension, regular rhythm, symmetrical, which compares well with apex beat; temperature 98.4; respiration 20.

Regional. Ears, eyes, and nose negative. Mouth negative except slight coating of the tongue. Face: eyes sunken, bony markings prominent. Neck, thyroid, slight diffuse enlargement. Heart and lungs normal. Abdomen, short and wide. Slight relaxation of abdominal muscles. Concave epigastrium with protrusion in the umbilical region. Large peristaltic wave rolling across the abdomen from above downward from right to left in the middle segment. These appear three finger breadths above and three finger breadths below the umbilicus, disappearing beneath the right costal arch. They occur two to a minute. Splashing sound is present over this area and marked gurgling is heard on pressure to the right of the navel. Stomach tympany reaches to the lower border of this area three finger breadths above the umbilicus. On inflation the greater curvature of the stomach extends to three finger breadths above the symphisis, and the lesser curvature two finger breadths above the umbilicus. Laterally the stomach extends from the right to the left axillary line. A skiagram of the stomach immediately after taking Riegel's bismuth meal practically confirmed the above findings of inflation of the stomach. No tumefactions were palpable before of after inflation. A squirting murmur is heard at the end of each peristaltic wave by ausculting over the right border of the above area. Liver extends from the seventh rib to the costal arch in the mammary line on percussion. Lower border is sharp, surface smooth, not tender or pulsating. Spleen is not enlarged on palpation or percussion. Kidneys: entire right kidney is palpable and distinctly mobile on palpation, not tender; left kidney is not palpable. No other important findings in the abdomen. Vaginal and rectum examination negative. Nervous system: all tendon reflexes markedly exaggerated; conjunctival, corneal; and pharyngeal reflexes present; no marked sensory disturbance. Trousseau's phenomena positive. Three or four minutes after constricting the middle of the arm the hand became considerably cyanosed. At this time the patient remarked, without knowing the purpose of this examination, that the hand felt as it did when she would commence to have her convulsions. Very soon after this the fingers began to stiffen so that it was impossible to bend them; then the extended thumb began to be adducted into the palm of the hand. The flexors of the forearm began to contract, gradually flexing the fingers in an extended position over the adducted thumb in the palm of the hand. The whole hand in this position was then gradually flexed on the forearm. Accompanying these contractures was a complaint of severe pain and the patient said that that was the position that the hand assumed in the beginning of her convulsions, and that this spasm would gradually creep up the arm to the trunk and body. Immediately after the constriction was relieved the patient would grasp her hand and rub the same until the muscles relaxed, which would relieve the pain. Chevostek's and Hoffmann's signs were not typically present, but on tapping the face along the angle of the jaw and over the branches of the seventh nerve, occasional fibulary contractions would take place in the upper lip and around the eye. The test for electrical irritability of the muscles and nerves was not made.

Stomach analysis, April 10: Stomach emptied without any previous preparation (no test meal). Patient had taken a cup of milk three hours, an orange three and a half hours, and crackers four hours previous. No obstruction to the passage of the tube, contents easily procured. Color, greenish. General character, almost entirely fluid, containing fibers of orange and finely divided food-stuffs. Chemical: Highly acid. Congo, dimethylamidoazobenzol, Gunzberg, and Boas tests positive. Kelling and Straus test (lactic acid) negative. Butyric and acetic acid negative. Free HCl 20. Total acidity 80. Albumin button digested in 24 hours. Metts tube .5mm. digested in 24 hours. Boas-Rennin test positive in dilution of one to 640. Pathological fermentation, very small amount in 24 hours. Benzidine and guaiac test negative. Microscopic: Muscle fibers negative. Yeast cells positive in twos. Sacinæ negative. Starch cells numerous. Fat globules many. Bacteria, many short-rod bacilli; few other forms. Leukocytes and erythrocytes negative. Epithelial cells, few squamous.

Stomach analysis, April 20: Previous preparation, stomach lavage followed by scraped beef and milk toast fourteen hours previous to test meal. Ewald breakfast removed in one hour. Important findings, free HCl 46. Total acidity 92. Albumin button digested in 24 hours. Metts tube .55mm. digested in 24 hours. Boas-Rennin test positive in dilution of one to 640. Pathological fermentation negative. Microscopic: Muscle fibers positive. Yeast cells in twos. Sacrinæ negative. Starch cells numerous. Fat negative. Bacteria, many short-rod bacilli, gram negative. Leukocytes and erythrocytes negative. The findings of chronic hypersecretion could not be

demonstrated as the stomach was empty in the morning after giving stomach lavage in the evening and allowing nothing by mouth during the night. Animal experiments. (The stomach contents used for these experiments was not fresh, having been kept for several weeks before it was used for this purpose.) Guinea pigs and rabbits were fed with the stomach contents without producing convulsions or any other noticeable symptoms. Subcutaneous inoculation in a rabbit with a filtrate of the contents caused death from sepsis without the production of convulsions. Two cc. of an alcoholic extract given intravenously and subcutaneously produced no perceptible change in the rabbit.

Urine examination: Single specimen. Amount, 130 cc.; color, dark yellow; transparency, clear; reaction, neutral; specific gravity, 1026; nucleo-albumin, trace; serum albumin, dextrose, bile, blood, indican, and skatol, negative; microscopically, occasional hyaline casts, many squamous epithelial cells, few polynuclear leukocytes.

Diagnosis. Anatomical, benign stenosis of the pylorus, dilatation and ptosis of the stomach, floating right kidney, slight parenchymatous goitre. Clinical, gastric tetany.

Operation. May 7, 1907. Ether anæsthesia, median incision. Examination of the stomach revealed a cicatrix encircling about three-fourths of the pylorus, causing almost complete obstruction of that orifice. No adhesions around the pylorus. Stomach greatly dilated. Walls markedly hypertrophied. No other abnormal findings in the abdomen. Short loop posterior gastroenterostomy, suture method, performed.

Course since the operation: Patient recovered from the operation rapidly; with the exception of a slight stitch abscess made an uneventful recovery. Her diet was gradually increased to a solid diet which she was able to take without any gastric disturbances after three weeks. She gradually gained weight and since this time, now over a year, has been entirely free from gastric symptoms and has never had a recurrence of spasms or convulsions. An attempt was made to demonstrate Trosseau's phenomena three days after operation without success, and since this time this sign has not been able to be elicited.

OCCURRENCE

That gastric tetany is a rare condition will be surmised by referring to the bibliography giving the authenticated cases obtainable. Gumprecht collected 40 cases reported up to 1897. Reigel was able to collect only 27 cases up to 1903, of which 16 proved fatal. Boas refers to 35 cases found up to 1907. The largest number of cases compiled was by Edwards who collected 101 cases combined from Reigel, Albu, Frankel-Hochwart, and others.

PATHOLOGY

The pathological lesions present in this disease have been variable. An analysis of the cases reported up to the present time, however, establishes a common functional result caused by these lesions — that of mechanical obstruction of the outflow of the stomach. The following lesions have been reported as the etiological factor producing this obstruction: 1. Cicatricial stenosis of the pylorus due to a previous gastric ulcer has been found in a majority of the cases (Kussmaul, Gumprecht, Fleiner, Caird, Cunningham and others); 2. Malignant stenosis due to carcinoma (Kuchinan, Juergensen, Seivers, Boas, Reigel); 3. Sarcoma of the pylorus (Fleiner); 4. Compression of the duodenum by gall-bladder filled with stone (Blazicek); 5. Compression of the duodenum by pancreatic cyst (Berlitzheimer); 6. Torsion of the stomach (Miller); 7. Foreign body in the stomach (Warbasse). Besides these causes, 8. Entozoa (Reigel) and 9. Chronic diarrhœa (Ewald and Jacobson) have been found associated with this form of tetany. Strictly speaking, however, if we are to define gastric tetany accurately we cannot include the latter two causes. They are due to intestinal and not gastric lesions, and it would be more proper to term these cases "enteric tetany." With the exception of these latter two, the pathological lesion in every case has been one which has caused mechanical obstruction to the motility of the stomach, and we feel justified in affirming the conclusions recognized by Germain-See and Berlitzheimer that this mechanical gastric disturbance is the most important etiological factor. This lesion need not be limited to one of the seven above, but might be any other intrinsic or extrinsic process causing chronic obstruction of the pylorus or duodenum. No other important lesions are reported. Loeb has described kidney, and Feranini brain lesion, which were apparently the result of toxic influences.

Pathogenesis. Three theories have been advanced to explain the cause of these convulsions: 1. Dessication of the tissues; 2. Reflex irritation; and 3. Auto-intoxication. Kussmaul attributed the convulsions to loss of water and consequent dessication of the tissues. This theory might be applied to what we have

called enteric tetany due to chronic diarrhœa. Miller and Reigel describe cases in which the convulsions have been produced by mechanical irritation of the stomach, and Miller supported on this ground the theory of reflex irritation. As these two theories have practically been discarded we will not consider them further. Many French and German authors have endeavored to establish Bouchard's hypothesis of auto-intoxication. Toxic substances, peptotoxins (Bouberet and Devic), and diamins (Kulneff), have been isolated from the stomach contents of these cases which when inoculated into animals produced more or less typical attacks of tetanic convulsions resulting in the death of the animal in some of the experiments. Alkaloidal bodies have been isolated from the urine (Ewald, Jacobson, and Albu) which were afterwards not present when the patient had recovered from this condition. These bodies have produced tetanic convulsions in animals in some instances, but not in all the cases or experiments. These experiments, then, while they are suggestive, have not absolutely established a theory of auto-intoxication. On the contrary, Cassaet and Ferre were able to isolate substances from gastric juice of persons not suffering from tetany which would produce convulsions when inoculated into the animal. Fleiner and Gottleib employed the peptotoxin manufactured after the manner of Bouveret and Devic and produced a clonic contraction of the animal but not the tonic variety of contractions resembling tetany. The experiments of Gumprecht, Haliburton and McKendrick with these extracts of stomach contents and urine were unsatisfactory.

CLINICAL COURSE

In discussing the clinical course of this condition it is necessary to consider both the developing gastric symptoms and the terminal characteristic attack of convulsion. The abdominal symptoms will depend entirely upon the kind of lesion producing the obstruction of the pylorus. We cannot go into detail regarding the symptoms of these numerous lesions as each has its own peculiar clinical picture. No matter what the lesion may be, however, the clinical course and findings of a high grade of motor insufficiency of the stomach is usually presented. These symptoms and signs combined with the characteristic convulsions of tetany, the same as due to any other cause, produce a fairly classical and simple picture of this very serious disease. In the majority of cases the attacks of convulsions were usually preceded by prodromal symptoms in the abdomen referable to the stomach, such as fulness, distention, nausea, gastralgia, etc. The onset of the convulsion is usually sudden, beginning with sensory disturbances in the hands and feet which are soon followed by spasms of the distal flexor muscles extending rapidly to the muscles of the extremities and body. The slightest convulsive phenomena are those of creeping, numbness, formication, and slight tonic contractions, particularly located in the hands and face. These slight symptoms may be present for a long time without developing into the classical convulsion, or they may immediately precede a typical attack of a generalized convulsion. For this reason such symptoms associated with gastric disturbances, should always lead to a careful examination of both the stomach and the nervous system. Ury describes attacks of tetaniform convulsions in the extremities without the presence of a generalized convulsion, which were associated, however, with more or less disturbance of consciousness. Cases have been described in which the clinical picture varied between tetany, tetanus, and epilepsy. In some of the cases of a favorable course, temporary disturbances of the intellect, loss of memory, disturbance of vision and speech were present. Unconsciousness for a varying length of time occurred in some of the graver cases reported. Trousseau classifies three different degrees of tetany according to the extension of the convulsion. 1. A mild type in which all the muscles of the extremities are seized. 2. A medium type in which, besides the above, muscles of the trunk, body, abdomen, and face are involved; and 3. A grave type including the muscles of the larynx, pharynx and tongue. The pathognomic sign of tetany convulsions which differentiates them from convulsions due to other causes, is the fact that some of them can be reproduced by mechanical or electrical stimulus during the interval between

the attacks. Symptoms referable to other organs are those due to inanition and those produced by the special lesions causing obstruction of the pylorus. Imbert-Gourbeyre, Belpech, and Rabaud observed that albuminuria was present in fatal cases.

DIAGNOSIS

The positive diagnosis depends upon demonstrating, first, the finding of an obstruction of the pylorus, and second, characteristic muscular contractures, some of which are reproducible by mechanical or electrical irritability and excitability. The diagnosis of obstruction to the pylorus in these cases is usually easy because the stenosis has reached a high degree before the convulsions occur. In the majority of the cases food remains, which had been taken from 12 to 14 hours previously, were found in the stomach or vomitus. The kind of stenosis must be determined from other clinical data, which space forbids us to consider at this time. Diseases which might be confused with this condition on account of similar gastro-intestinal symptoms are especially the gastrointestinal neuroses associated with abdominal ptosis. These do not present the clinical picture of second degree motor insufficiency of the stomach, nor do they have the severe muscular reproducible spasms which are characteristic of tetany.

The demonstration of the characteristic convulsions of tetany, which are the same in this variety as those due to tetany from any other cause, is made by eliciting the following pathognomic signs. These signs are present during the intervals between the attacks of convulsions.

1. Trousseau's phenomena or the mechanical irritability of the nerves. This sign is produced by constricting the arm, which causes the typical contracture in the hand and forearm. Whether these contractures are due to pressure upon the nerve or the blood-vessel is yet an open question. In our case we believe it is due to compression of the veins because the contractures in the hand did not occur for three or four minutes after continuous pressure had been made over the nerve. The contractures did occur constantly about one minute after the hand had become markedly cyanosed.

2. Chovestek's and Hoffmann's phenomena or mechanical super-irritability of the facial nerve. This sign is elicited by tapping the branches of the facial nerve which produces a contraction of the muscles supplied by the individual branch of the nerve thus irritated.

3. Erb's phenomena, or increased galvanic and faradic irritability of all the motor nerves except the facial. According to Frankel-Hochwart this phenomena cannot be entirely accepted. He maintains that there is an increased galvanic irritability present in all the cases, but that the faradic irritability is normal in the majority and only increased in a few.

Other diseases which must be differentiated from gastric tetany on account of having convulsions similar to this affection are hysteria, epilepsy, occupation neuroses, acroparæs-thesia, meningitis, brain tumor, rickets, thyroid and parathyroid affections, acute infections, nephritis, intoxications (ergot, morphine, and lead) eclampsia and tetany occurring during the pueperium and lactation. Thirty-two cases of tetany occurring during the puerperium, and fifteen cases of tetany due to syphilis (Howard) have been reported. All of the above conditions are easily differentiated from gastric tetany by: 1. The absence of positive signs of pyloric obstruction; 2. The absence of three cardinal pathognomic signs of tetany; and 3. By the clinical symptoms peculiar to the individual disease under consideration.

PROGNOSIS

The prognosis of gastric tetany has always been considered very grave. The mortality under medical treatment up to the present time has been 88 per cent. The cases reported by Kussmaul, which were treated in this way, resulted fatally. Soltau Fenwick reported a case in which death took place after 16 hours of tetany, during the first seizure. Bouervet and Devic gave the mortality as 70 per cent and Meumann's estimation of the mortality in his report was 72 per cent. Until the surgical treatment was introduced nearly all the cases died in one of the attacks. Since this treatment has prevailed the mortality has been reduced to 37.5 per cent. The prognosis of the individual case depends necessarily upon the nature of the lesion producing the obstruc-

tion of the pylorus. If this is a malignant obstruction, as has been the case in about 10 per cent of the cases reported, the prognosis is necessarily very unfavorable even under surgical treatment. As the majority of these cases are due to lesions which can be relieved by surgical intervention the present mortality should be greatly reduced, providing the condition is recognized before other counter-indications for operation arise.

TREATMENT

Prophylactic treatment of this condition is very important. It deals with properly caring for these lesions before they cause any serious obstruction to the pylorus. This is another argument for a radical surgical treatment of chronic ulcers, cholelithiasis, etc. The nature of the pathological lesions precludes a curative medical treatment. Symptomatic treatment, however, during the attacks, must be given expeditiously. This consists of stomach lavage, hypodermoclysis, protoclysis, and morphine hypodermically. Radical surgical treatment, depending upon the lesion present, is the only rational treatment that should be considered. This was first advocated by Mayo Robson who has reported three cases cured by this means. Fleiner (two cases) Gumprecht, Caird have reported cases due to cicatricial stenosis of the pylorus which have been cured by operation. Cunningham has collected eight cases, and Warbasse has collected six cases which were also cured by this method. Jennosco collected eleven cases which had been operated upon with eight recoveries. The operation of election depends necessarily upon the conditions present in the individual case. In the majority of the cases operated upon successfully, pyloplasty or gastroenterostomy was performed.

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DEPARTMENT OF TECHNIQUE

THE MANAGEMENT OF LARGE INGUINAL CANALS

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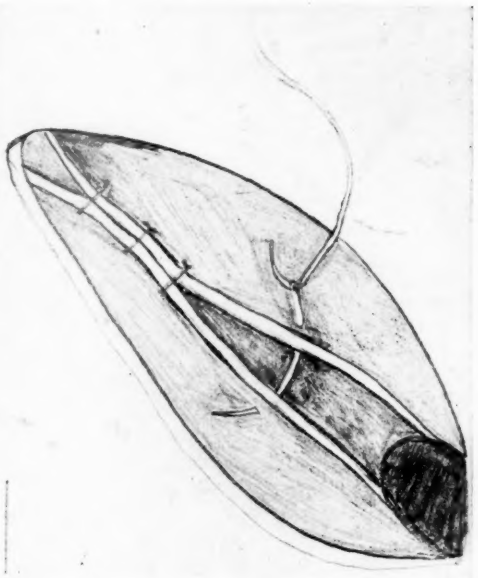
Every surgeon of experience has frequently encountered enlarged inguinal rings in which were to be observed no hernial sacs but which were so dilated that it seemed the occurrence of well-marked hernia was imminent. Besides these cases there are many in which the dilatation of the canals is less marked and others in which the beginning of hernia formation to the extent of the formation of a bubonocele has already taken place.

The treatment of these cases is to be considered with some care. The application of the Bassini principle of hernia operation is inadmissible on account of the manifestly unnecessary traumatism of opening the entire inguinal canal. It is quite possible, as the writer showed a number of years ago, to close the internal ring by passing sutures through the internal pillar on the one side and around Poupart's ligament on the other, utilizing the opening of the external ring for that purpose. But this method is a little difficult to practice and was for that reason abandoned in favor of other plans.

Kocher's *verlagerungs* or displacement method of treating fully developed hernia contains a suggestion which the writer has often used with good effect.

The essential point in the displacement method consists in the pressing back into the abdominal cavity of the sac, previously dissected free for the purpose, and the drawing out of the sac through an adventitious opening in the anterior abdominal wall made for that purpose. This displacement of the sac has nothing in it especially to commend it to our attention, despite the arguments of its great originator. The position which the sac occupies is of no importance after the completion of the operation in comparison with the other infinitely more important factors in the permanent closure of the abdominal wall. It is the approximation of the pillars to one another after adequate dissection that gives assurance that a return of the difficulty will not take place. The sac so readily undergoes atrophy that it cannot in any way be regarded as a sufficient buttress to the breach to make it worth considering when we have to deal with problems of such grave mechanical import as those involved in the recurrence of hernia. No secondary consideration must be allowed to enter into the inquiry which will obscure the main issue of the work, namely, the closure of the canal by means of sutures which bring together the pillars in such a way that the integrity of their union will admit of as little question as possible.



Semi-diagrammatic sketch to show the application of sutures modified from Kocher.

The success of Kocher's method is unquestionable in suitable cases. But the limitations of the procedure are strictly laid down by the author of the method himself in a manner so plain that none can doubt that the technique should be carefully limited to the simplest cases of breech. Strangely enough, while setting down with the greatest care these limitations, which exclude definitely the severer forms of the malady the author of the

method presents his readers with a statistical comparison of the merits of the two procedures which easily results in favor of the displacement method. The unfairness of the comparison seems to have been overlooked.

The original point in this operation, if indeed it is original, consists in the method by which the sutures are applied. This consists in the depression of the cord, its displacement backward by the finger of the operator so that the pillars stand out distinctly on each side of the canal, easily palpable and easily seen, while through the tissues thus exposed sutures can be easily passed, encircling the internal pillar on the one side and Poupart's ligament on the other.

In Kocher's picture (Operations-Lehre, Vierte Auflage) the suture is made to pass *under* the external oblique aponeurosis. We have been in the habit of passing it *over* this structure.

In cases where an operation is to be performed upon a patient for some trouble located in another part of the body which does not threaten the recovery of the patient in too great a degree, the dilated rings may be closed in a few moments, if one uses the technique we refer to, especially after a little practice is obtained in the work. The class of cases suitable for this procedure are cases of varicocele, well-developed hernia on one side with dilated rings on the other, clean appendix and gall-bladder cases, and operations upon the extremities. Many other associated difficulties may in this way be attended to. The principal thing to remember is that one is rarely to operate for this condition alone, since the majority of such anomalies never come to any serious end, and that the associated condition must not be such as will complicate wound-healing or be so serious that the added traumatism of closing the canal is of consequence in the matter of danger to life.

If an area which is contaminated by the presence of infectious matter must be exposed during the operation the work upon the canal must be done before the other part of the operation is attempted.

The technique which I have used is as follows: Make an incision one inch to one inch and a quarter long over the canal and parallel with it. This cut goes down through the skin and superficial fascia to the external oblique aponeurosis. This structure will as a rule not be seen at once upon making the incision. When the skin has been opened the fatty superficial fascia is seen, usually only partly incised. With two blunt instruments, which are set side-by-side at the middle of the wound, pressed deeply into the abdominal wall and then forcibly separated, the dissection down to the aponeurosis is completed. This structure is recognized by the color and by the appearance and direction of its fibers.

The ring is now to be felt and to be seen. Its walls and the aponeurotic anterior surface are freed of fat by rapid movements of a dull instrument, and the finger can then be laid upon the anterior wall of the canal and used to repress that structure. This manœuver causes the lateral walls of the canal, the internal pillar, and Poupart's ligament to stand out prominently. It is important that the pillars be felt and seen distinctly at this time for, otherwise, it is impossible properly to adjust the stitches. If the pillars are thus made to stand out distinctly the stitches may be inserted easily as indicated in the accompanying semi-diagrammatic drawing which has been modified from Kocher.

As many stitches as are desired may be applied. But as a rule two or three are used. Chromicised catgut is usually preferred. The external wound is closed in the usual manner. As a rule the external epigastric artery is seen and may be transected and afterwards ligated, but with a little practice the artery may in most cases be avoided, thus saving time and the application of a ligature which must, of course, be buried.

The results of this procedure leave nothing to be desired. Healing as a rule is by first intention and there is a permanent diminution of the size of the opening, with practical immunity from the tendency to hernia formation. It must not be forgotten that the internal ring is to be carefully closed by carrying the highest suture above the limits of that ring and by embracing in its grasp the internal pillar as well as Poupart's ligament.

A NOTE ON OPERATION FOR DISLOCATION OF THE SHOULDER AND OF THE HIP

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Professor of Surgery in the University of Birmingham. Surgeon to the General Hospital

Open incision for the reduction of dislocation of a large joint is, happily, a procedure rarely required. For this reason such operations seem worth recording, not merely on account of their rarity but because the details may be of use and guidance to others who contemplate operations. The difficulties in replacing the dislocated parts will vary considerably in each joint according to the exact nature of the dislocation, the age and muscularity of the patient, the time which has elapsed since dislocation occurred, and the manner in which the interval has been spent, whether in fixation and rest of the distal portion or in liberty and movement.

It goes almost without mention that healing free from suppuration is essential to a good result, may indeed be essential to the patient's life as well as to the utility of his limb, and unless conditions likely to secure aseptic repair are present the patient had better accept his dislocation and make the best of it with the knowledge that he will in the large majority of cases have a fairly useful limb limiting him only in certain movements which are generally not essential. From time to time one sees, for instance, men who have followed laborious occupations for years with unreduced dislocation of the shoulder joint, able to use a shovel or to wheel a barrow and to do a great deal of manual work sufficiently well, but of course with their action in the main limited to underhand movements.

The two dislocations I am about to describe came under my notice within a few weeks of each other, one being of the shoulder, the other of the hip; the detailed accounts are as follows:

Mr. X, aged 30, a very muscular subject, was thrown from his horse when riding and sustained a dislocation of his left shoulder which was not recognized until I saw him five weeks after the accident. The dislocation was subcoracoid, this was confirmed by a skiagram, movement of of the arm was very limited, the deltoid was extremely wasted, pain was complained of slightly in the ulnar nerve distribution but the vessels were quite free from pressure. The extreme wasting of the deltoid which had been recognized before I saw the patient was attributed to an injury to the circumflex nerve, and I think it likely that this nerve had been damaged though not torn through, in view of the present well-developed condition of the muscle.

A thorough attempt at reduction was made under anæsthesia but without success and six weeks after the injury operation was performed. An incision was made, extending from just above the clavicle downwards for five inches following the interval between the pectoralis major and the deltoid. Powerful retraction of these muscles exposed the coracoid process and the muscles attached to it. The coraco-brachialis and the short head of the biceps were found to be so tense as to require division to give access to the deeper parts and they were cut through about an inch from their origin. The capsule of the joint was opened over the long tendon of the biceps and the head of the bone identified as lying under the root of the coracoid process, on the neck of the scapula just internal to the anterior margin of the glenoid cavity; the cavity itself was normal and presented no obstacle to reduction of the dislocated head. With the finger and raspatory the tissues on the inner side of the capsule were carefully pushed away to ensure that no injury should be inflicted on vessels and nerves if they were adherent and an unsuccessful attempt at reduction by Kocher's method was made. Then with my own hands manipulating the humerus and my assistant making powerful traction downwards and then outwards an endeavour was made to restore the head of the bone to the glenoid fossa by thrusting it directly over the margin of the glenoid but without result. Powerful transverse traction by a blunt hook around the neck of the humerus was next applied but failed to overcome the obstacle presented by the broad powerful tendon of the sub-scapularis. This tendon was now divided, transverse traction with the blunt hook was re-applied with leverage from the elbow and the head of the bone was replaced in the glenoid cavity. All the divided tissues except the sub-scapularis were sutured; the the portions of this muscle were so widely separated that approximation was impossible. The wound was drained for three days, perfectly aseptic union was obtained and passive movements of the joint were commenced on the tenth day. At the end of the fourth week carefully restricted active movements were allowed and at the end of another fortnight without restriction.

Twelve months have now elapsed since the operation during which time there has been steadily increasing freedom in the use of the joint. The head of the bone rotates quite freely, overhand movements can be effected, the muscles about the shoulder are but slightly less developed than those on the right side. The patient is able to play golf and shoot without inconvenience; but there is still a little tendency to rotate the scapula when the arm is freely raised.

The second patient was a boy, aged 13, with a dislocation of the right hip, admitted to hospital March 3, 1907, with a history of an injury about a month previous. The patient received his injury when sliding on some ice, at which time he fell and found that he had hurt himself, his leg felt stiff but when some boys who were with him had twisted it outwards the lad went back to his work on the farm for several hours. He returned home in the evening and was put to bed, but though he remained at home he got about in the house and garden for the next few weeks, at times suffering from mere stiffness, at other times from acute pain.

Fig. 1.

On admission to hospital there was much swelling about the right hip joint rather irregular in shape, lobulated somewhat and projecting to the size of an ordinary orange over the front of the joint, this swelling was fluctuating and the skin over it was discolored as though it had been severely bruised, movements of the right leg produced pain and there was much limitation of movement in all directions, there was very slight eversion of the right foot and measurement showed half an inch of shortening of the right lower extremity. Dislocation was suspected and this view was confirmed by radiography, but a certain diagnosis without radiography was impossible owing to the amount of swelling around the joint.

Plate 1 shows the condition of the displaced part before an anæsthetic was given and it confirmed, too, what had previously been suspected, that the head of the bone did not occupy either of the positions of a regular dislocation but that it lay on the iliac bone vertically above the acetabulum.

Five weeks after the injury an anæsthetic was given and an endeavour made by forcible extension and subsequently by manipulation to reduce the head of the femur but this could not be effected. In view of the swelling in front of the joint which although probably a collection of blood might be an inflammatory condition, it was considered wise not to prolong manipulations.

Operation. The incision adopted was that for excision of the joint by the anterior method, several ounces of blood clot and serum were evacuated partly from in front of the joint and partly from the distended capsule of the hip, the capsule was found much thickened by recent inflammation. The head of the bone was found unaltered and lying on the margin of the acetabulum pretty directly above that cavity, the acetabulum itself was fully occupied by the stump of the ligamentum teres greatly thickened by granulation tissue. An endeavour was made to reduce the dislocation by manipulation but this failed; using the shaft of the femur as a lever and at the same time by pressing with the hands on the head of the bone an attempt was made to return it directly to its proper cavity, but this also failed as did powerful extension. The obstacle at this stage which prevented approximation of the head of the bone to the acetabulum was a portion of the anterior part of the capsule which the most forcible extension failed to overcome, but

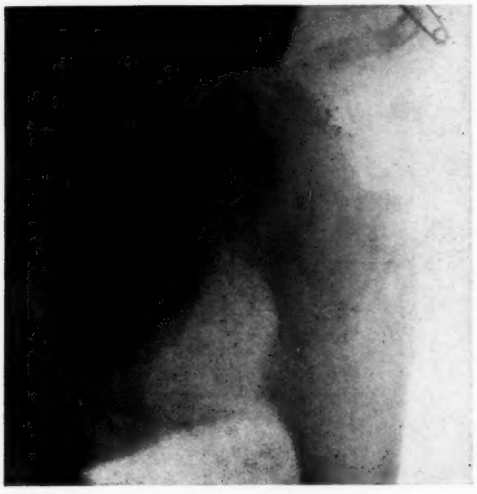

Fig. 2.

when this had been freely divided with scissors the head of the bone could be placed in apposition with the margin of the acetabulum. It could not however be placed in the cavity until this had been thoroughly emptied by curette and raspatory of the swollen and succulent ligamentum teres; when this material had been removed the dislocation was reduced (see Plate 2). The front of the capsule was sutured, provision for drainage being made by a puncture through the gluteal fold and the patient was fixed in a box splint, great care being taken to keep the limb rigid whilst the apparatus was being applied. The splint was retained until the 23d day when it was left off, the boy was still kept in bed and passive movements only were allowed. On the 34th day the boy was allowed to get up on to the couch and active movements were permitted. On the 42d day after the operation he was able to walk alone without support from any other person. When examined nine months later there was not the least trace of lameness, the movements of the joint were free in all directions, abduciotn gave no sense of insecurity and the patient was doing laborious work in an engineering shop.

A most important point demonstrated by this case is the impossibility in such a case of replacing the head of the bone in the acetabular cavity until that cavity has been emptied. Attempts at reduction without an incision were in my opinion bound to fail because of this. It is possible that in ordinary dislocations of the hip when the parts have been kept at rest the filling up of the acetabulum may not be nearly as extreme as it was in this patient who had used the injured part with some freedom. Comparing the difficulties met with in the two cases here recorded I can say unhesitatingly that repacement of the head of the humerus was much more difficult than replacement of the head of the femur.

AN INTRAPERITONEAL METHOD FOR THE RADICAL CURE OF ABDOMINAL HERNIAS[1]

By MICHAEL M. LUCID, M. D., Cortland, New York

Hernia is probably the most frequent disability from which mankind suffers. The most elaborate statistics are those of Malgaigne, in which he states that probably ten per cent of the population suffers from hernia in its various forms. It has been the odium of surgery for centuries, and it can be truly said that only within the last fifteen years has the surgeon been in a position to say to those affected that they can be cured. Earlier than the advent of Bassini's method for the radical cure of hernia the percentage of cures from radical operations did not exceed thirty-five per cent, and as was true then is quite similarly true to-day, when the operation was not a complete success, the patient was not only worse off than before, but possessed the added assurance that each succeeding operation quite strongly emphasized the uncertainties of a permanent cure.

Quite naturally, then, only cases of strangulated hernia came to operation, which added to the mortality, mainly on account of the delay and long continued manipulations previous to the operation; but since Bassini — the Italian surgeon whose discovery of the solution of the anatomical difficulties and the surgical principles of this operation has been made known to the profession — many cases come to the surgeon thoroughly conscious of the uncertainties attending the wearing of a truss,

[1] Read at the Medical Association of Central New York, at Rochester, N. Y., October 15, 1907.

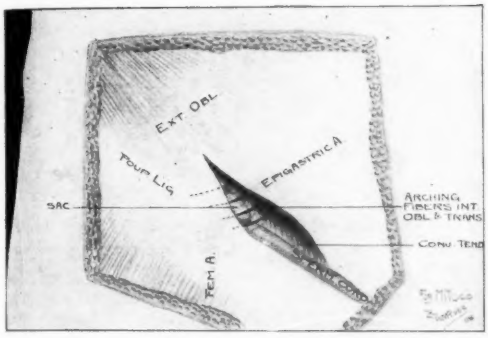

Fig. 1. Showing stitches passed from within abdomen and their relations to epigastric vessels and spermatic cord in male.

which is attended with more or less disability, and associated with the attendant dangers of life from strangulation, demanding that the hernia be cured if possible before it reaches the stage where strangulation is probable, until now the operation is in use the world over, with various modifications.

It is not my intention in this short contribution to make reference or comparison to the various methods in use for dealing with abdominal hernias, but it is to submit for your consideration an intraperitoneal method that I have used, at first incidentally, since January, 1904, for dealing with abdominal hernias in connection with intraabdominal lesions when it was found necessary to open the abdominal cavity.

I therefore offer this contribution to the study of femoral and inguinal hernias, simply as a preliminary report, together with such original drawings as are necessary to illustrate the operative procedure, and at the solicitation of various colleagues who have witnessed the performance of the operation and have been interested in its feasibility from the standpoint of simplicity and anatomical economy.

With brief reference to the originality of the operation, I desire to state at the outset, that after correspondence with various surgeons of note, together with careful perusal of the literature at my command, I have found no reference made to the performance of intraabdominal herniotomy for the cure of inguinal hernia, except in Ferguson's Modern Operations for Hernia, brief reference is made in two instances, in both of which the external ring is opened from without.

Any procedure, aside from obliterating the sac and the space previously occupied by the sac, together with restorations of the pillars of the internal abdominal ring, plays no anatomical part in the permanent cure of abdominal hernias. The closure of the incision from without is largely obliterative, not unlike in principle to the constant wearing of a truss, and the same results, I believe, may be obtained in small and moderate sized hernias by reduction of the sac and contents and constricting the ring from within the abdomen.

Formerly the main and usual cause of hernias was summed up as primarily a relaxation of the internal ring, which may be either congenital or acquired, permitting the peritoneum to stretch (a fact proven by Merey as early as 1701), the result of intraabdominal pressure, which if continued dissects its way outward, appearing between external structures; to this rightly should be added the fact evolved in the investigations of Coley, that there previously existed a congenital peritoneal depression at the site of the developed hernia.

From my limited experience with the method herein described, I am not at present prepared to advise opening the abdominal cavity solely for the performance of intraperitoneal herniotomy, yet I refer to it as a possibility of the future with improvement in technique; but what I most desire to emphasize in this communication is the probability of safely closing inguinal and femoral hernias of small or moderate size from within the abdomen, especially in the female, incidentally to the performance of abdominal operations when it is necessary to open the abdominal cavity. Intraperitoneal methods are advised and practiced, and the abdomen opened for malposition of the uterus, which in reality causes no less disability than does inguinal or femoral hernia, that formerly were treated by external incision, as

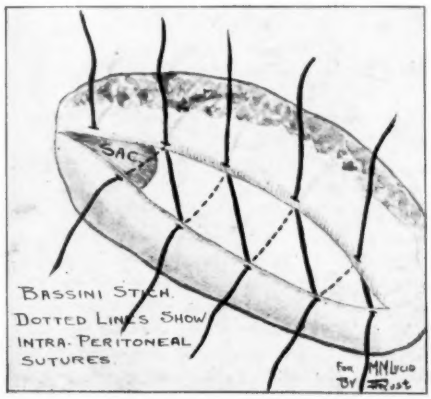

Fig. 2.

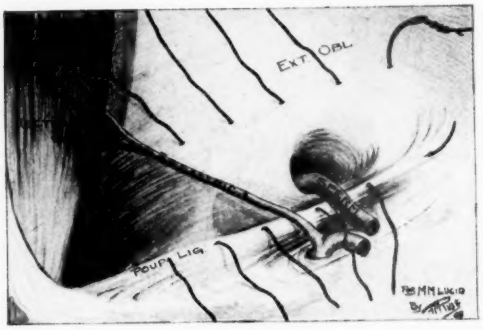

Fig. 3. Showing the sutures passed through the arching fibres of the transversalis and internal oblique muscles coming out on the internal surface of Poupart's ligament before tying.

the Alexander operation, but not with as brilliant results, owing to herniæ following the operation in some instances, as has attended the intraabdominal methods for shortening ligaments.

I therefore submit for your consideration such methods as I have used in ten selected cases, the history and result in each case appended. While sufficient time has not elapsed since the performance of these operations to emphasize its usefulness, and formulate definite conclusions, still the results from this operation have been gratifying beyond expectations, as no recurrences have been recorded in cases operated upon over two years ago, following the technique herein described.

In the four cases of femoral hernia in this series, I have used practically the same technique in dealing with the sac, assisted if necessary by taxis, with the inversion and ligation of the sac from within the abdomen concluding the operation.

Ochsner, in his book on Clinical Surgery, says that any attempt at closure of the femoral canal after reduction of the sac has a tendency to invite recurrence. Consequently, he concludes his operation for femoral hernia by simple ligation and excision of the sac from without, and returning the stump within the abdomen, depending upon the spontaneous closure of the canal.

The end results of the operation apparent in my experience of the ten cases are, that the combined operation has decided advantages over the performance of the two operations at the same or different times. To the patient it eliminates, so to speak, one operation, as does the removal of a diseased appendix through the same incision in the performance of an operation for ovarian cyst, and it requires but very little extra time in addition to the primary operative procedures, with the added probabilities of greater firmness of the abdominal wall, as it is certainly preferable to have but one incision, when otherwise two would be required to deal with both conditions.

The principles of the operation are: 1. The obliteration of the fossa or canal, previously occupied by the hernia, by sutures passed from within the adbomen building uq a permanent support of tissue in front of the peritoneum; 2. And insuring a flush closure of the peritoneum at the point where it first became dilated from the general peritoneal cavity in the primary formation of the hernia, thus eliminating the starting-point of a subsequent recurrence.

The requirements for the operation demand that the contents of the hernia must be completely reduced into the cavity of the abdomen, for the operation thus far has only been appropriate to the cases of reducible hernia, and those which are not of large size, reference being made herein only to femoral and inguinal hernias.

ANATOMY

In the discussion of any form of hernia it is always wise to review briefly the gross anatomy and general surgical and anatomical relations of the parts and structures that of necessity we must refer to in the course of our paper; and regardless of time spent in the study of anatomy and dissections, to the surgeon there is always something new and fascinating about the anatomy of the groin, rendering it a broad field for the exercise of surgical ingenuity, and the technique involved in operative procedures in this region. I therefore offer no apology for calling your attention briefly to the anatomical boundaries of the inguinal canal, which is one and one-half inches long in the male and two inches long in the female. Accurately speak-

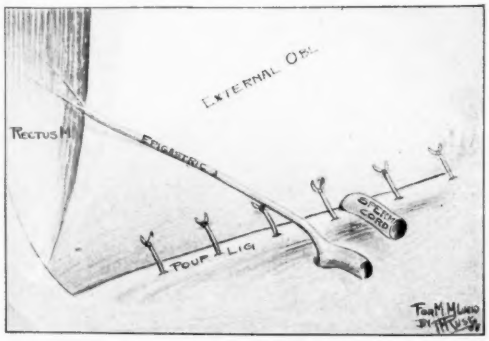

Fig. 4. Showing sutures when tied, bringing arching fibres to shelving edge of Poupart's ligament.

ing, it is not a space, but occluded by the apposition of its anterior and posterior walls. It is bounded behind by the triangular ligament at its inner end, and by the conjoined tendon and the tranversalis fascia; above by the arching fibers of the internal oblique and transversalis muscles; and below by Poupart's ligament, to the posterior shelving margin of which the transversalis fascia is attached; and for a short distance at its inner end by Gimbernat's ligament. The contents of the inguinal canal in the male are the spermatic cord, the ilio-inguinal nerve, which lies in front of the cord, and the genital branch of the genito-crural nerve, which runs in the cremasteric fascia on the dorsal surface of the cord. Its contents in the female are the round ligament of the uterus, the ilio-inguinal nerve, and the genital branch of the genito-crural nerve, both of which lie anterior to the ligament in the canal.

The structures entering into the region of the inguinal canal are: 1. Peritoneum; 2. Extraperitoneal fatty tissue; 3. Three muscles; 4. Four fascias and 5. The conjoined tendon. The extraperitoneal fatty tissue is a most important structure in this instance in its relation to the inguinal canal. It surrounds the cord and is attached to it, affording an easy passageway between the abdominal cavity and scrotum, with but the thin layer of peritoneum acting as a barrier to a potentially open route. Surrounding the deep epigastric vessels and lateral to them are bundles of dense connective tissues which are developed in the fatty tissue, and extend from the inner margin of the internal abdominal opening to the outer end of the semilunar fold of Douglas. These fibers connected with the outer-lying transversalis fascia form what is known as Hasselbach's ligament, a structure which plays a most important part in rendering the internal abdominal ring patulous during increasing abdominal pressure, and explaining how hernias occur by a separation of the muscular plane which lies anterior, either by disease or age, allowing the bowel to slip anteriorly to Hasselbach's ligament and down the inguinal canal. It is very important that these fibers be included in passing the sutures, to be described later in this article.

The fibrous bundles, developed from the fatty tissue which pass out of the pelvis into the conjoined tendon, give to the abdominal wall its chief support internal to the inguinal canal, while the aponeurosis of the transversalis fortifies the wall internal to the external abdominal ring. The fibrous bundles that enter the conjoined tendon from without the pelvis are, in femoral hernia, the constricting agent, and were so named by a Spanish surgeon, Gimbernat's ligament.

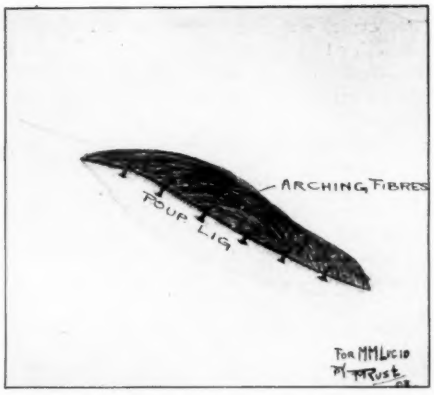

Fig. 5. External view. Construction of entire canal from within the abdomen of the female.

The deep epigastric artery which arises from the external iliac artery from one to two inches above Poupart's ligament passes upward and inward between the peritoneum and transversalis fascia, passing directly between the internal abdominal ring and the fossa from which escapes the direct inguinal hernia.

This artery, which lies just exterior to the peritoneum, indicates exactly where the needle should be passed, through Hasselbach's ligament, into the arching fibers of the transversalis and internal oblique muscles, thence across the opening from above downward into the posterior shelving margin of Poupart's ligament for constriction of the opening after the sac has been reduced and excised, but before either the ligation or overlapping of the stump, which may be slit open parallel to Poupart's ligament, if extra exposure is demanded.

In the direct hernia the needle is inserted to the front and inner side of the epigastric artery, and in the indirect variety to the outer side of the artery, bringing the needle through the posterior shelving margin of Poupart's ligament. In fact, in the female there is no anatomical objection to constricting the entire inguinal canal from within the abdomen, corresponding to the Bassini or Ferguson operation from without the abdomen, as the ilio-inguinal and genital branch of the genito-crural nerve both lie anterior to the round ligament.

The internal abdominal ring itself lies a finger's breadth above Poupart's ligament and midway between the two points of attachment of the latter, an important consideration in the passing of the needle. Two stitches I believe sufficient to constrict the ring if of small or moderate size, but additional stitches can be passed if necessary, without injuring important structures.

The hernial sac usually passes out through the ring anterior to the cord in the male, while in the female the descent is in the canal of Nuck, following the round ligament into the inguinal canal, consequently the constriction of the internal ring should be above and in front of the vessels.

TECHNIQUE

After the abdominal cavity has been opened and the primary operation completed, the operation for internal herniotomy is performed by the observance of the following technique in the order submitted:

1. Place the patient in the Trendelenburg position.

2. Reduction of the sac and contents, aided if necessary by taxis and the use of forceps grasping the apex. (It is surprising how a sac, apparently fastened by bewildering adhesions to surrounding structures, can be inverted.)

3. Torsion of the sac to ascertain at what point to amputate, the length of the stump depending upon the size of the ring to be closed and covered by peritoneum.

4. Guided by the finger and a short double tenaculum, a sharp curved needle, threaded with celluloiden linen, is passed through the arching fibers of the transversalis and internal oblique muscles (which come into view by the retraction of the peritoneum after amputation of the sac) from above downward, across the ring, including the posterior shelving edge of Poupart's ligament to constrict the opening, the number of stitches depending upon the size of the opening to be closed; thus overcoming the tendency of Hasselbach's ligament to reopen the ring when intraabdominal pressure is increased, and strengthening the canal at its weakest portion, the internal ring. In the female, the sutures may be passed with greater freedom, as the constriction of the round ligament would be of slight importance. Interrupted or continuous suture may be used.

5. The stump of the sac I have dealt with in two different methods, the one by ligation en masse, the other by overlapping the edges, using No. 2 chromic gut for the same.

6. Concluding the operation by closing the abdominal incision.

The best authorities upon the subject of oblique inguinal hernia state that the key to the radical cure of the same is to suture the internal oblique muscle and its tendon to the inner aspect of Poupart's ligament as low down as possible, without undue tension, after the ablation of the sac and strengthening the internal abdominal ring with a few stitches placed at and above the root of the cord. The same can be accomplished by the intraabdominal route without the additional incision, or the subjection to a secondary operation.

The surgical axiom that any cavity in the human anatomy devoid of serous or mucous membrane will close spontaneously, here asserts itself, which process is aided materially in this instance by relief from intraabdominal pressure, which is instituted in the after-treatment by keeping the foot of the bed elevated sufficiently for the first week, to keep the abdominal viscera from coming in contact with the seat of the operation.

Classification of the ten cases is as follows:[1]

4 femoral, all women, pelvic tumors.

6 inguinal:
- Direct, 2, both men: Appendectomy; Undescended testicle
- Oblique, 4, 2 women: Internal Alexander
- Oblique, 4, 2 men: Selected hernia

In conclusion, permit me to say that unremitting work is in progress to perfect the technical details and to lay down the precise indications for the operation, together with the scientific significance of the results. This, however, is already clear to my mind, that the method possesses certain features, the application of which in selected cases excludes the necessity of but one incision.

[1] Since writing the paper I have operated with success upon six cases of inguinal hernia in connection with intraabdominal tumors.

THE DIAGNOSIS AND TREATMENT OF VESICAL CALCULUS

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One of the oldest recognized conditions in surgery is that of stone in the bladder, an operation for which was originated many centuries ago. A vast amount of literature is available upon this subject, yet notwithstanding the fact that the condition is one of rather frequent occurrence, and our knowledge of the subject rather complete, many times the condition is overlooked until well along in the course of the disease, and the stone is so large that it produces an exaggerated group of symptoms which make the diagnosis at this time more or less easy. Yet, even after our diagnosis is made, the number, size, and formation of the stones ascertained, we are at a loss frequently to know what mode of treatment is best for the patient. It will be my object in this essay to bring clearly to view the various forms of treatment, and to discuss the efficacies and fallacies of each.

The cause of the formation of the stone is not absolutely known, yet from the study of the stone itself, and a correct knowledge of the normal elements found in the urine, we may arrive at some theoretical explanation. It must be remembered that normal urine contains about ninety per cent of water, in which are dissolved ten per cent organic and inorganic materials. The organic substances are urea and uric acid; of these uric acid plays an important part in the formation of stone, for although it exists in the proportion of only 1 to 1000 in the urine, it enters into the formation of a large proportion of vesical calculi. The inorganic constituents in the urine are sodium, potassium, and magnesium, the bases with which the uric acid unites. These bases also unite with sulphuric and phosphoric acids to form corresponding salts. If any of these substances are present in the urine in excess of their normal amount, they then form deposits and their particles accumulate around a nucleus and a stone is the result. It has been shown that uric acid crystals usually form the nucleus.

Stone is very much more apt to form in the presence of either a mild or excessive inflammation either where there is presence of pus, blood, or a marked desquamation of epithelia, any one of these acting as an excellent nucleus for the accumulation of crystals.

It is not the object of this article to go into details as to the etiology of vesical calculi, but to discuss the diagnosis and treatment. The most common forms of vesical calculi, given in the order of their frequency, are uric acid stone, oxalate stone, and phosphatic stone. These may occur in the bladder singly or in numbers. A single calculus is usually rounded or oval in shape. Multiple calculi are most frequently phosphatic in character. Vesical calculi may vary as to size from a few grains to 24 or 25 ounces.

There is no set of symptoms absolutely and characteristically pathognomonic of stone in the bladder. The diagnosis must be left entirely to the facts elicited by the surgeon's examination; however, with a certain group of symptoms stone may be suspected, the most important of these being frequency of urination, pain, and hæmaturia, occurring by day and increased by exercise. Pain associated with this condition is usually intense, and the frequency of micturition marked. These two symptoms usually appear early in the disease and are what brings the patient to the physician for treatment. The pain and frequency are more marked by day and increased by exercise, while at night when the patient is lying quietly they subside. As the pain and frequency are increased by exercise, it is the natural tendency for the patient to exert himself as little as possible, for every jolt induces spasm; even when walking the patient will be exceedingly careful and walk slowly. Frequently riding in automobiles or trains will produce an exaggeration of this condition. Pain is particularly noticed in the glans penis, pendulous portion of the urethra, and perineum.

As the stone grows larger and the inflammation in the bladder becomes more intense, the symptoms become more exaggerated, the frequency is increased, and the pain is more intensified, the person urinating from every ten to fifteen minutes both by day and night. This condition is very apt to bring on exhaustion to the patient from loss of sleep. With a patient having this combination of symptoms, together with possibly a history of renal colic, stone in the bladder may be suspected.

Some of the text-books claim that a symptom which is prominent and of great value, is the sudden arrest of the flow of urine. This event, when it occurs, is of vast importance, for the arrest of the urine is almost always due to the presence of a small stone, which during micturition rolls into

Fig. 1.

the mouth of the urethra acting as a ball valve, and obstructs the flow of urine. This symptom is absent in so many of the cases, that it is only of value as a positive symptom. An accurate diagnosis must be left to the examination of the surgeon.

The important methods of diagnosis are as follows: use of the stone searcher, cystoscope, and X-ray. The most favorable of these instruments in the hands of the general practitioner is the searcher, for it requires no special amount of technique for its use, and in a large proportion of cases stone may be discovered, yet in some cases stone may even be overlooked with this instrument, and other methods must be used to ascertain its presence.

The best time for the examination of the patient with the searcher is during the period when the suffering is less. It may be necessary to cocainize the urethra and bladder to overcome the irritation of the examination. Four or five ounces of sterile water should be put into the bladder, per catheter, to distend that viscus for instrumentation, thus facilitating the search. The patient is placed in the dorsal position, the hips slightly raised, and operator standing to one side. The searcher is introduced exactly in the same manner as passing the sound. It is then pushed carefully to the posterior wall of the bladder with the beak upward, withdrawing it slightly to give easy play to the end in the bladder, then carefully turn the beak from side to side until the lateral walls of the bladder are touched. This may be accomplished by rotating the instrument between the thumb and fingers. The beak is then turned downward so as to examine the posterior wall of the bladder, and in this way the entire viscus may be examined. This manipulation will most likely discover the stone if it is present. If the prostate is enlarged the handle of the instrument should be depressed and rotated from side to side as it is carefully withdrawn.

Many times it is necessary to make frequent examinations before stone is detected. After the presence of the stone has been ascertained it is necessary to determine if there is more than one stone. This, however, is best left to the use of the cystoscope.

Cystoscopy of the bladder for diagnostic purposes is a far more scientific method of examination than the use of the searcher, yet unfortunately the technique of this procedure is more difficult, and the general practitioner is not so familiar with its use. Cystoscopy is not a difficult procedure and the results obtained are far more trustworthy than by any other means of examination. The technique of cystoscopy is exceedingly important; although the methods are very simple they must be rigidly performed. The important points of technique are asepsis and antisepsis. The essentials necessary for the performance of cystoscopic examinations are — a meatus and urethra large enought to admit the instrument, a bladder that is not too contracted to hold at least four ounces of fluid, absence of any lesion along the urogenital tract which will render the fluid too cloudy from pus or blood to allow of an examination. This may be entirely overcome by making the examination under continued irrigation. The bladder or urethra must not be too irritable; it, however, is not common that this is the case; a little cocain

Fig. 2.

about two per cent in strength may be placed in the urethra if that part of the tract is too sensitive to allow the instrument to pass. A general anæsthesia is almost never necessary. A better method of anæsthesia is that devised by Dr. Bransford Lewis, who recommends the use of alypin in tablet form. In over 6000 cystoscopic examinations the author has found it necessary to resort to general anæsthesia in only a few cases.

The patient is directed to remove the clothes; it is better to have them all removed both in male and female. The author uses pajama suits which are slit from the waist band in front to the waist band in the back; the patient is thus covered completely with the exception of the external genitals. The patient is now put upon the table in the extreme lithotomy position with the hips slightly elevated, thus preventing an escape from the bladder when the instrument is in place. There are many tables which may be used to advantage for this purpose, but the best of these is one manufactured by Kny, Scheerer & Co., New York, fitted with Bierhoff leg supports.

The meatus and glans penis are washed with a solution of oxycyanide of mercury $\frac{1}{5000}$, bladder irrigated with the same solution only $\frac{1}{50000}$. This may be done with a soft rubber catheter or through the instrument if it be so constructed. Irrigation should be continued until the outflow is perfectly clear. If the bladder is not too contracted eight or ten ounces should be allowed to remain in the bladder when the catheter is removed. The temperature of this solution should be a little cooler than the urine.

It is suggested that the American instruments be used, for with these the bladder can be irrigated through the instrument, thus avoiding the passing of any unnecessary instruments, which reduces the possibility of infection and of urethral irritation. The patient having been prepared, the instrument thoroughly sterilized, the hands and arms of the operator sterilized by any of the ordinary methods, the clothes covered with a sterilized gown, we are ready for the examination. The cystoscope can not be boiled owing to the fact that this would melt the cement which holds the lenses in place, thus permitting the water to leak behind them and thus render the instrument useless.

Several methods of sterilizing instruments have been suggested, such as placing them in a solution of carbolic acid, solution of formalin, or solution of oxycyanide of mercury. The latter seems to be the best method, the solution used in the strength of $\frac{1}{5000}$. This does not affect the material in the instrument, nor does it cause any irritation in the urethra. The cystoscope should be kept in this solution about five minutes. If carbolic acid solution or formalin be used the operator must wash the instrument in sterile water prior to passing it along the canal, for both the acid and the formalin would produce an irritation and would interfere with the examination. The lamp should be tested prior to the passage of the instrument into the urethra; the instrument is connected with a battery or to the street current of the direct variety controlled by a rheostat. The current is gradually turned on until the lamp burns with a white light. It is then thoroughly lubricated with any of the ordinary lubricants, such as glycerine, boro-glycerine, etc. Oil or vaseline should never be used for a lubricant for any urethral instruments.

In passing the instrument into the canal it is accomplished much on the same order as the passage of the ordinary metal sound, but owing to the short beak the outer end must be carried well downwards between the patient's thighs, thus allowing the beak to slip through the prostatic urethra into the bladder. The current is turned on, the lamp burns bright within the transparent fluid, thus lighting the bladder and by looking through the telescope the bladder walls may be clearly seen.

Fig. 1 shows the variety of table recommended by the writer, as well as the position of the patient upon the table. The legs are supported and separated, and the hips are elevated by lowering the head of the table. This makes a very comfortable position for the patient, with relaxation of the abdominal muscles. This also shows the method of passing the instrument into the urethra.

There is a little knob on all instruments situated on the outer end to show the operator on which side the beak is pointed. This is of use, for after the instrument is turned around so the base of the bladder is to be examined, pulled in and out, turned from one side to the other, the correct position of the instrument for removal may be ascertained. The instrument in place, it may be readily moved back and forwards, rotated, lowered or raised, and inclined to either side.

Fig. 2 shows position of the patient upon the special cystoscopic table with the cystoscope in place and the operator examining the bladder through the telescope. From the position of the instrument shown in this cut, the operator is examining that portion of the bladder adjacent to the right ureteric orifice.

The operator must be familiar with the optical construction of the cystoscope before an exact outline of the picture of the bladder wall may be understood. The cystoscopic telescope consists of a tube having an objective at its vesical end, and an eye-piece at its external end. The objective

consists of one or more lenses which throw a small inverted image of the opposite object proportionate in size to its index of refraction, into the interior of the tube, where it lies close behind the objective and is reinverted by a lens in the middle of the tube and then transferred to its outer end against the eye-piece, which acts as a magnifying glass and enlarges the image. The image as seen through the eye-piece varies in size according to the distance at which it is removed. The more perfect the lens system, the larger and clearer the image.

The size of the bladder surface, as seen in the inner field of the vision, is increased as the instrument is withdrawn, but the details of the picture become less distinct; the size is decreased as the instrument is moved nearer but the outline of the picture is sharper and clearer. If the object is placed about four-fifths of an inch from the lens its natural size will be seen. If these optical facts are lost track of, two errors are liable to occur; first, and most important, the bladder picture will appear distorted because the distant portions of the picture will be diminished in size, while the nearer parts will be magnified; second, the true size of the object may be lost, owing to the fact that the size of the image is either diminished or decreased in proportion to the relative nearness or distance of the objective. Experience will soon enable the operator to eliminate the element of distortion of the image and to tell correctly its size.

The best rules to follow in ascertaining the relative size of objects in the bladder are those so clearly shown by Viertel in his table as follows:

With 4.5 mm. distance, magnification of 3.8
With 7.5 mm. distance, magnification of 2.7
With 10.0 mm. distance, magnification of 2.2
With 16.5 mm. distance, magnification of 1.5
With 28.0 mm. distance, magnification of 1.
With 33.0 mm. distance, magnification of 0.9
With 51.0 mm. distance, magnification of 0.6
With 70.0 mm. distance, magnification of 0.5

Thus we see that at a distance of 4 mm. a magnification of four (4) times occurs, at a distance of seven (7) a diminution of one-half occurs, and that at a distance of 28 mm. the objects are seen at their correct sizes. Each cystoscope varies a bit as to this distance and it must be ascertained individually.

The W. K. Otis instrument is considered one of the best for bladder examintion for it gives a field four times larger than any other instrument. This is accomplished by substituting a hemispherical lens for an ordinary prism.

Figs. 3 and 4 represent the Otis cystoscope in its entirety. Fig. 3A shows the cystoscope barrel with the electrical attachment, with opening just before the beak and tube join. With this instrument in place the bladder may be thoroughly irrigated. Fig. 3B represents the telescope in position, the lens being seen at the opening. This also shows the electric light. Fig. 3C gives an idea of the manner in which the bladder may be viewed as seen through the lens. Fig. 4a shows the relative size of the telescope. Figs. b and c give in detail the appearance of the lens, showing its hemispherical character, thus giving a field four times the size of that gained by any other instrument. This lens, however, bows the field slightly but, after the operator becomes accustomed to its use, this slight objection may be discarded.

Cystoscopic diagnosis is in every way more accurate and scientific. The picture obtained will

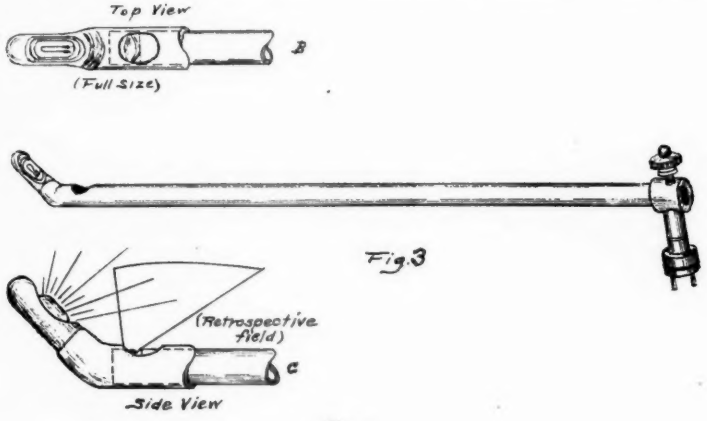

Fig. 3.

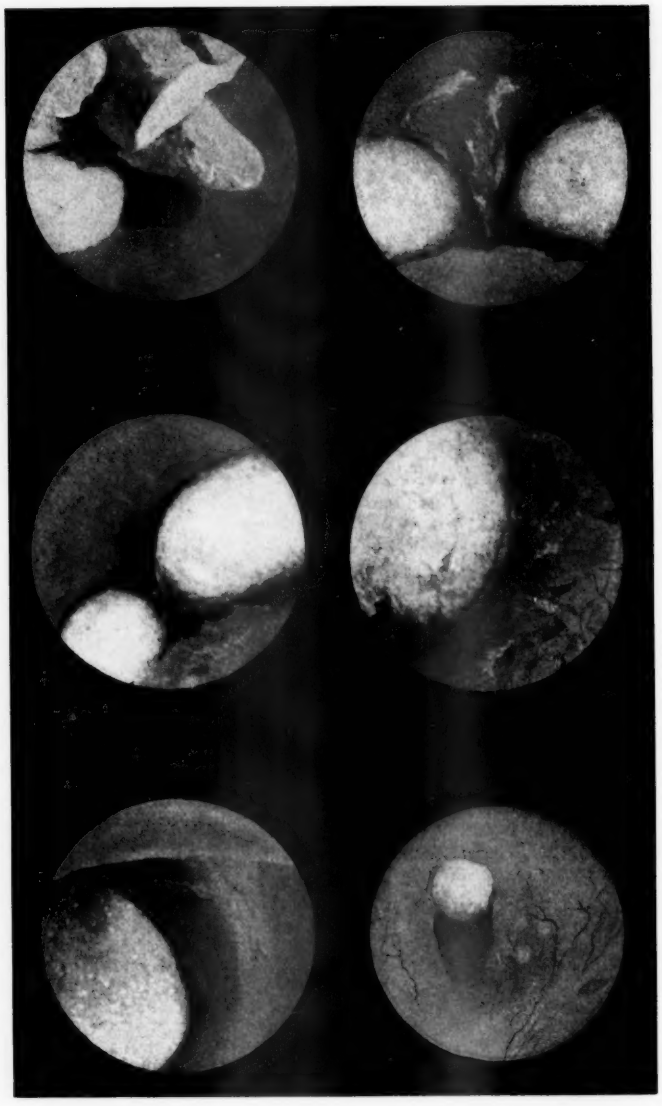

Fig. 10. Fig. 9.
Fig. 8. Fig. 7.
Fig. 6. Fig. 5.

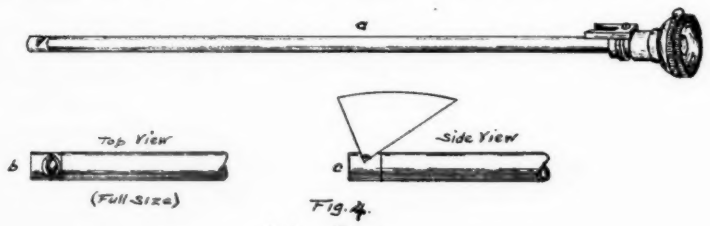

Fig. 4.

inform us as to the number, formation, and size of the stone, and will show the precise condition of the bladder mucosa. The picture will also give us certain data as to the appearance of the ureteric orifice, and thereby such evidence that we may expect kidney lesions complicating the bladder condition.

Fig. 5 shows an exceedingly interesting and typical cystoscopic picture of a newly formed stone in the bladder. It is resting on the floor of the bladder immediately behind the right ureteric orifice. It is about the size of a pea, and owing to the rays striking it perpendicularly it casts a rather long shadow on the bladder wall. Behind and to the left of the orifice there is an area showing a marked cystitis granulosa. (See colored plate).

These, Figs. 6 and 7, represent a view of the same stone but in different positions. In Fig. 6 we see upon first introducing the cystoscope, one pole of a large, yellowish brown stone which has an irregular, fine-grained surface projecting into the field, situated immediately behind the internal sphincter. The stone throws a wide shadow, as may be readily seen. (See colored plate).

In Fig. 7 we see a picture of the same stone, the size of which is estimated to be about that of a walnut. We obtain here a posterior view, adhering upon the upper surface of which may be seen a dark red muco-purulent membrane. The bladder shows clearly a beginning trabecular condition, and small particles of pus may be seen floating around in the fluid. (See colored plate).

Figs. 8, 9, 10, show three different views of a bladder stone in the same patient. The first two, Figs. 8 and 9, portray what was seen at the first examination. The last picture shows the result, after the first sitting, of lithotripsy. In the first two, Figs. 8 and 9, we see two stones about the size of walnuts lying close under the margin of the sphincter. In the first picture, Fig. 8, we see the stones as the rays of light strike them perpendicularly. In the other, Fig. 9, they are illuminated by direct rays. Lying between these two stones may be seen two long, fibro-purulent shreds. In Fig. 10, we see the debris following lithotripsy. This is shown very beautifully. These stones were too large to allow the operation to be finished at one sitting. (See colored plate).

The diagnosing of urinary calculi by means of the X-ray is one of the fine arts, requiring a good knowledge of physics, electricity, and photography. Any physician who is willing to give the time and attention necessary to master the details of the process can succeed in making a diagnosis by this method that is seldom open to question. Any apparatus that is fairly efficient may be used for this purpose, all the way from an 8-inch to a 60-inch coil, or some of the larger types of static machines, if properly used, will give very satisfactory results. As a general proposition much better work can be done by means of the coil than by static machines, and for this reason this type of apparatus is very much more under the control of the operator than the other.

The principles at stake involve the absorption of a certain definite quantity of energy passing through tissue of different densities, and the more efficient the apparatus in the average individuals' hands, the less likely they will be to obtain success, owing to the fact that the great velocity obtained by the ray, from the apparatus of this type, shows a disposition to obliterate the slight difference in densities.

To succeed with any type of apparatus, we must calculate our penetration very carefully, in order that we obtain a ray of just sufficient velocity to pass through the part and polarize the silver of the photographic plate. It is not generally known that with the X-ray, as ordinarily used, a great amount of its chemical value is lost, owing to its passing through and beyond the silver emulsion of the plate. This fact has been taken advantage of, however, by experts in order to get absorption from the rays of different velocities. In other words, for accurate work where some question of the diagnosis is entertained, we use two very thin films, placed face to face over the ordinary photographic plates used in the skiagraph. Each one of the these plates absorbs a

certain definite amount of energy or a certain wave length, and as the three plates are all developed under the same conditions, they are placed one above the other and examined in a viewing stand.

It is found that by this method many times the shadow of a stone, which does not show up upon any of the plates singly, will show beautifully when three of them are super-imposed and viewed by transmitted light. The only objection to this method is the expense and increased amount of work which few physicians are willing or able to pay for at present.

Another method which has given fairly good results is the so-called compression diaphragm. This is a metal cylinder containing the X-ray tube, which is fitted over the abdomen, and the walls are compressed as far as the patient will tolerate. This gives us a field within the tube in which we immobilize all the parts beneath the tube. It also eliminates a disturbing feature, which is the cause of non-success in a great many types of apparatus, the so-called secondary wave. These rays under this technique are absorbed by the metal walls of the cylinder, and permits only the rectilinear rays to strike the photographic plate. It is seldom possible to get a quick exposure of a stone in the kidney, owing to the fact that a great volume of rays passing through the field obliterates the slight differences in density, so that as a rule we use a comparatively small amount of energy and increase the length of time of exposure, ordinarily using from three to five minutes for a subject weighing 150 to 175 pounds. The tube to be selected is one that will give us a parallel resistance of from two and a half to three and a half inches.

If we have a subject with a tendency to a redundant abdomen, we can increase our penetration under these conditions, by putting a spark gap upon either side of our X-ray tube. These spark gaps have the effect of increasing the penetration of the X-ray. The developing of the X-ray plate for a kidney stone is one that requires a great deal of practical knowledge of photography. As a general rule, the best results are obtained by using what is known as a contrasty developer, and diluting this with about fifty per cent of water we tend to intensify the slight difference in density and thereby bring out these shadows of a kidney stone.

It can be stated that the X-ray when properly used in people of a normal build, can be depended upon to give a reliable diagnosis of kidney calculi. In the technique of bladder calculi some variation in methods is necessary, owing to the fact that the conditions within this organ may vary within wide limits. The quantity of fluid retained by the position of the tube, and the position of the patient in reference to the tube, and the plate, all have a practical bearing upon the success with this procedure.

With the ordinary calcium stones, it is sufficient to empty the bladder, and by adjusting the target of the tube at sixty degrees to the plane of the plate, we can succeed in passing a pencil of rectilinear rays through the pelvis and projecting the shadow of the stone upon a photographic plate This, of course, rather tends to increase the distortion or size of the shadow, so as to give as an example the idea of the exact size of the stone. This is due to the great distance of the stone from the plate.

With some of the softer varieties of stones, especially of the uric acid type, another method must be adopted in order to make them show up satisfactorily. In this case we evacuate the bladder and inject either sterile air or oxygen gas. The air carries the energy of the ray with very little absorption, tends to displace the surrounding structures and will give, by contrast, a very sharp shadow of a uric acid stone.

Much better results are obtained by using some type of diaphragm in order to exclude from the field all the rays that are not in the rectilinear. This can be done by ascending the rays through a little screen with an opening, by some of the various types of tube protectors, or where advisable, the ordinary compression diaphragm now used in the majority of laboratories.

In every instance, before an attempt is made to diagnose a stone of either the kidney or the bladder, a thorough evacuation of the bowels must be brought about. Especially must this be done in stone of the bladder, in order to avoid a mistake in the interpretation of the resulting diagram. For bladder work this method is about the most successful and the presence or absence of a stone can be ascertained without any question of doubt.

The foregoing remarks upon X-ray diagnosis and technique were kindly dictated for me by Dr. Gordon G. Burdick, who is considered an expert upon matters appertaining to X-ray diagnosis and treatment.

The one great difficulty in X-ray diagnosis in vesical calculi is the fact that it requires expensive special apparatus and skilled manipulation. In the large city the X-ray specialist may be consulted, but in the out-lying districts the general practitioner must resort to other means of diagnosis.

The mode of treatment of a vesical calculi is either lithotomy of litholapaxy. Lithotomy is

divided into the perineal route, and the suprapubic route. The latter of these is the one most commonly used. I will not dwell upon these operations; their technique may be found in any text-book on surgery. The operation for crushing the stone in the bladder, or lithotrity as it is called, combined with washing out the fragments through an evacuator, called litholapaxy, is to my mind a far better procedure in the majority of cases, and accompanied with less risk than the more radical operative procedures. The suprapubic or perineal lithotomy exposes the patient to far greater dangers than does litholapaxy. Lithotomy, however, is adaptable to all cases, while litholapaxy is adaptable only in selected cases.

Litholapaxy requires a certain amount of special training to enable the operator to accomplish good results. Any surgeon may perform lithotomy without special training. There is no doubt that litholapaxy performed by a skilled operator is the safest operation that can be performed upon the bladder. The operation may be performed in any individual who is free from a few contra-indications, which will be mentioned later.

All stones may be crushed if they can be caught in the jaws of the lithotrite. I do not believe that there are any stone formations which are too hard for the jaws of the lithotrite to crush. The size of the stone, however, may present a contra-indition for the operation of litholapaxy, yet the operation may be done in several sittings. I do not deem it advisable to work for a long period of time at one sitting.

The important contra-indications for litholapaxy are as follows:

1. Conditions involving the urethra, or prostate, which will prevent the passage of the instrument.

(*a*) Hypertrophy of the prostate.

(*b*) Impassible or resilient stricture of the urethra.

2. Inflammatory conditions in the bladder of such extent that a cystotomy would be deemed a better procedure.

3. Tumors of the bladder.

4. Stone being encysted or adherent in such a position that it is impossible to grasp it with a lithotrite.

5. In stone formation where the nucleus is due to a foreign body too large to pass the urethra.

6. Cases in which the kidneys are markedly affected and below their normal functional activity. In such conditions any operative procedure would be contra-indicated.

All these conditions may be readily ascertained by a cystoscopic examination of the bladder and the operator is liable to base his conclusions for either method of operating from his cystoscopic findings. I am personally in favor of litholapaxy over any other form of surgical procedure for vesical calculi, and with the improvements of the lithotrites, the operation is much more easy of accomplishment than it was in the old days.

In taking up litholapaxy I think it would be wise to insert here some reference to the technique of the operation. The treatment preceding the operation is important. If the patient is suffering from cystitis, he should be placed in bed, on a light diet, and lavage of the bladder performed daily, thus endeavoring to clean up the inflammation, so that the operation may proceed with as much freedom as possible from complications.

The patient should be prepared the night before the operation, as in every major operation. The instruments required for the operation, besides the ordinary contents of the operating room, tables, basins, towels, etc., as follows — one stone searcher, one examining cystoscope, one or two ordinary lithotrites, one Walker cystoscopic lithotrite, set of sounds, several rubber catheters, one large syringe, two aspirators, and at least two tubes. Solutions of boric acid and oxycyanide of mercury.

The ordinary lithotrites are fully described in most text-books of surgery, and I refer my readers to them for detailed description, yet I will describe in full Walker's cystoscopic lithotrite, which is one of the newest instruments devised with which the operator may have less difficulty in picking up and crushing the stone.

An instrument of exceptional value is a new combined lithotrite with a cystoscope, devised by Dr. George Walker of Baltimore. There are several of these instruments on the market, those of Nitze, Bierhoff, and Casper, but these all have the great disadvantage that one blade of the lithotrite is interposed between the prism and object to be seen. Moreover, owing to the mode of their mechanical construction they are necessarily too weak to crush any stone that is not very soft and relatively quite small.

Dr. Walker's instrument is shown in the accompanying cuts. It is constructed sufficiently strong to stand the strain of seventy-five pounds, which is ample for crushing any stone except those of the hard, oxalate type.

Figure 11 shows the complete instrument closed; (C) is a section looking directly between the open jaws onto the surface of the prism end of the cystoscope; (d) shows jaws open (side view). The instrument, Fig. 12, consists of a female blade (A) carrying a handle (ab); a male blade (B) carrying a screw (g); two attachments (e) for the

cystoscope and (f) for the evacuator; a cystoscope (C) and a steel rod (D). The female blade, exclusive of the handle, is nine and one-half inches in length, in the straight portion it has a calibre of twenty-five French and in the curved of twenty-six French. It, as well as the other blade, is made of the very best quality of steel, highly tempered. The handle consists of two parts, a fixed (a) and a revolving part (b); (a) is firmly fixed to the blade, its surface is corrugated and it has two lateral flanges which prevent it turning in the hand; (b) the revolving cap is attached to the fixed portion by means of a ridge and a groove. It is provided with four metal pins on its surface, so as to afford a better hold. This cap is adjusted by means of a screw thread, to the end of the male blade (g), a device which readily provides for the opening and closing of the jaws.

The female blade and handle, except the revolving cap, are provided with an open slot, into which the ridge on the male blade fits. The distal end of the female blade is perforated so as to allow the fragments to pass through and to permit the end of the cystoscope to project when necessary. The male blade is a steel tube reinforced on the under surface by a ridge which fits into a slot of the female blade and prevents it from turning. On the proximal end of the male blade there is a cylindrical screw (g) on which the outer portion of the handle (the revolving cap of the female blade) turns. On the end of this screw two attachments can be fitted, one (e) for holding the cystoscope in place, and the other (f) for connecting the evacuator. The cystoscope (Fig. 12C) has a calibre of fifteen French; it is made with a small convex prism and the lamp is turned around so as to be close to the prism.

The attachment for the cord at the distal end is placed on the same side as the prism and lamp, and not on the opposite side as has heretofore been the custom. The electrical connection is made or broken by turning the gutta-percha end of the cord (Fig. 11E). The cap for holding the cystoscope is of the usual type. The attachment for the evacuating apparatus is made after the pattern of the end of the ordinary evacuating tubes, but so modified that it screws on the end of the male blade.

The steel rod (Fig. 12D) is the same calibre as the cystoscope; it is one-half an inch longer, and has a small flat handle on the proximal end. This is intended to pass through the instrument and clear it of any fragments which might become lodged on the tubal portion.

The instrument with one evacuator attached is shown in Fig. 13. This principle has been used for a number of years in the Chismore instrument; it is not, therefore, illustrated as anything new, but simply to show its adaptation to Walker's instrument.

The bladder is thoroughly irrigated until the returning fluid is entirely clear, 150 cc. of clear, sterile water being finally left in. The instrument, adjusted as in Fig. 11, is then introduced; the jaws are opened by turning the screw from right to left; the cystoscope is adjusted in such a way that the line of vision is between the open blades. The stone is then located and the male blade, which can be seen, is placed squarely in front of it, and the jaws are closed by turning the screw. Before the jaws are entirely closed the cystoscope is turned so that the prism surface will be protected. In some instances it is better to pull the cystoscope well back into the male blade so that it can not be injured by the stone. After the primary crushing the large fragments are sought for and broken. If, during the crushing, some fragments are forced into the tubal portion of the male or female blade, the cystoscope is removed and the steel rod passed through so as to clear the canal; after which the cystoscope is reintroduced. When the crushing is finished the cystoscope is removed and the evacuator attached (Fig. 13). After this, the lithotrite is turned around so that the convex surface rests on the floor of the bladder and the beak projects upward into the cavity. The jaws are separated from three-fourths to one inch, and the fragments are

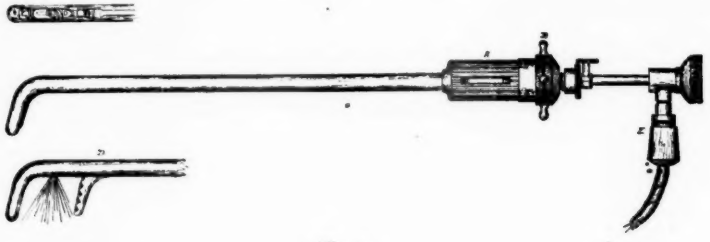

Fig. 11.

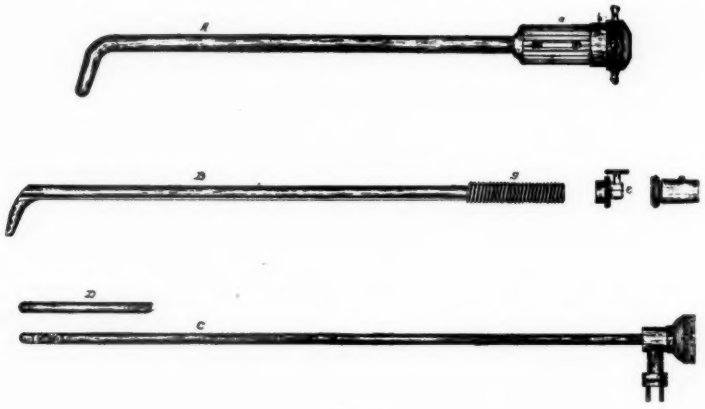

Fig. 12.

washed out in the usual manner. It there is any doubt as to the completeness of the operation the bladder is again filled with water, and the cystoscope reintroduced. In filling the bladder it is better to raise the outer end of the instrument so that the water will not run out; if it, however tends to do, so, the end of the finger may be held, over the opening. As the cystoscope is introduced, if there is much vesical contraction some fluid will escape, but the amount will be insignificant, and the deficiency can be easily provided for beforehand by injecting a little more than is necessary for proper distention. If the operation is done under cocain and the vesical contraction is violent, some leaking will occur during the whole operation, but if the bladder is quiet, the amount is reduced to a minimum and is not troublesome.

The object of this instrument is not to supplant suprapubic section or the use of the ordinary lithotrite, except in certain cases. It is intended to be used not for large or hard stones, but for small ones of the soft variety.

Litholapaxy may be performed in the office, but I prefer to have my patient in the hospital where he can have rest for at least twenty-four hours after the operation. My patient in the hospital is prepared in the same manner as for ordinary operation. It need not, however, be necessary to shave the pubic region.

The question of anæsthetic is an all important one. General anæsthesia is seldom ever necessary; in fact it is an advantage not to place the patient under the increased risk of general ether anæsthesia, as there may be a resultant kidney irritation. Some claim that it is not necessary to use any anæsthetic either local or general; others prefer the use of cocain in the urethra and bladder. If cocain is used it is better to have it made fresh in solutions of 2 per cent. In my experience I have found that most of the untoward effects which rise from the use of cocain are due to the surgeon using old solutions of the drug. With freshly prepared solutions, the ill effects of cocain are minimized. Most of the pain experienced by the patient is in the passage of the lithotrite through the posterior portion of the urethra. This may be readily overcome by anæsthetizing that portion of the canal by the application of tablets of alypin. These may be placed into that portion of the urethra by a very ingenious little instrument devised by my friend, Bransford Lewis, known as "tablet depositor." The tablets are deposited through this instrument and allowed to dissolve, and almost immediately produce their anæsthetizing properties. The crude drug coming into exact contact with the membranes produces a more thorough anæsthesia than does any drug held in solution. This drug alypin does

Fig. 13.

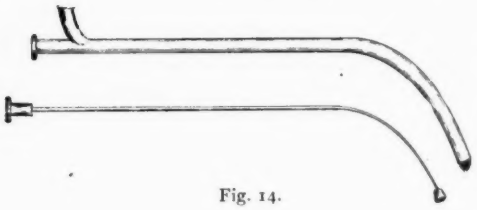

Fig. 14.

not produce any untoward effects similar to cocain.

The tablets are made of appropriate size, one and one-eighth grain, by the Schieffelin Company. In applying them the following plan is adopted: The patient first empties the bladder, or it is emptied for him by catheter; then the depositor is inserted as far as the posterior urethra (the anterior urethra does not usually require anæsthesia) where it is held while the obturator is withdrawn; a tablet is dropped into the depositor and pushed into the urethra by means of the obturator. After mascerating in the mucus of the urethra a minute or so the tablet becomes a soft mass, which is then smeared over the adjacent membrane by a to-and-fro motion of the depositor. Precise information can be obtained as to the disappearance of sensitiveness by inquiry of the patient. From two to four tablets may be used, according to necessity in the individual case, and manipulation should not be begun until the acute sensitiveness is reduced. (Fig. 14.)

Nitrous oxide gas may be used as an anæsthetic in this group of cases, particularly as the operative procedure is of short duration, not longer than fifteen minutes at a sitting. Recent experiments with nitrous oxide gas show that this anæsthetic may be used over quite a long period without any untoward effects. Spinal anæsthesia has been recommended for bladder operations, but as this method of anæsthesia has been used so little, particularly by the urologist, I can not recommend its use. Personally, I have had no experience with it whatsoever.

The choice of anæsthetic having been decided upon, the patient is placed upon the operating table in the dorsal position, the hips elevated by the aid of a small cushion 6 to 10 cm. in thickness The knees are slightly bent, and the thighs separated, sterile sheets covering the patient above and below, with a slit for the purpose of exposing the genitals. The bladder is thoroughly irrigated, and from six to eight ounces of fluid allowed to remain within that viscus. I prefer the use of a solution of mercury oxycyanide $\frac{1}{5000}$ strength for this purpose.

The passage of the lithotrite is rather difficult on account of the angle of the beak, and the skill of the operator is put to the test by the manner in which the manipulation of its passage is brought about. The instrument is passed much in the same manner as the ordinary metal sound, but owing to its peculiarly shaped beak, the external end must be lowered well between the thighs to allow the beak to pass through the posterior urethra and into the bladder. If the cystoscopic lithotrite of Walker be used, which instrument, to my mind, is the preferable one, the location of the stone may be readily ascertained, and the manipulation of grasping the stone between the jaws of the instrument may be easily accomplished. In the ordinary lithotrite seizure of the stone is accomplished by separating widely the jaws of the instrument and then depressing the female bladder in the median line of the lower vesical fundus. Usually the stone will drop between and be caught in the grasp of the jaws. These are immediately closed upon the stone and locked.

Cystoscopic examination of the bladder prior to the crushing will inform us as to the nature of the bladder wall, and we can then exert special care in avoiding catching a portion of the bladder wall in the grasp with the stone. This may happen if the bladder be columnar. To be on the safe side regarding this, the instrument may be rotated slightly to see whether the stone which is grasped by the jaws of the instrument moves freely from side to side. If the stone has been properly seized it will remain firm between the jaws, and the crushing may be begun by giving a few twists to the wheel. The fragments are then picked up one at a time, and as rapidly as possible crushed. After these particles have been thoroughly crushed, the aspiration of the debris is begun. This may be performed by any of the ordinary aspirators used for this purpose.

Some attention must be paid to the after-treatment, for too frequently the patient is allowed to continue in his ordinary mode of living without any treatment of the bladder, and there is apt to be a recurrence of the stone. Lavage of the bladder should be performed at least every other day for the first two weeks, and gradually reduced in frequency as the patient's condition improves.

Litholapaxy should be left entirely to the specialist, who has become skilled in the use of the lithotrite, or to the surgeon who is familiar with the operative procedure of the genito-urinary tract; however, one may become proficient in the use of the lithotrite by practice, the practice being performed upon the manikin, a special form having been devised for this purpose.

The treatment of the bladder before and after litholapaxy is particularly important and should not be neglected. I emphasize this part of the technique for the reason that any neglect may be productive of rather serious results, and with due care a prognosis may be very much more favorable.

In conclusion I wish to summarize my remarks by inserting a few rules as to the advisability of adopting one or the other of these methods of treatment in vesical calculi, lithotomy and litholapaxy. Lithotomy requires a general anæsthesia, litholapaxy does not; lithotomy is a major surgical procedure accompanied by more or less shock and more productive of untoward reflex kidney conditions that litholapaxy. Litholapaxy usually requires only a few minutes; however, it may be necessary to resort to more than one sitting. Lithotomy is an operation of longer duration. In litholapaxy the patient is allowed to attend to his ordinary duties after twenty-four hours, and is not laid up in bed for several weeks as is the case in lithotomy.

The dangers of sepsis are markedly reduced in litholapaxy, whereas the dangers of sepsis are markedly increased in lithotomy. Lithotomy is the better operation to perform in the very young, up to five or six years of age. Litholapaxy, if all the conditions are favorable, is the better procedure after this age. Many times the choice of procedure must be left to the opinion of the surgeon, and he can only reach his opinion by a careful, scientific, and accurate study of the individual, and the cystoscopic picture of the bladder, of the renal functional activity, the size and formation of the stone, and the amount of dexterity he himself possesses for performing either one of the two procedures.

A POSITIVE PRESSURE APPARATUS FOR INTRATHORACIC OPERATIONS. PRELIMINARY REPORT

By H. M. RICHTER, M. D., Chicago
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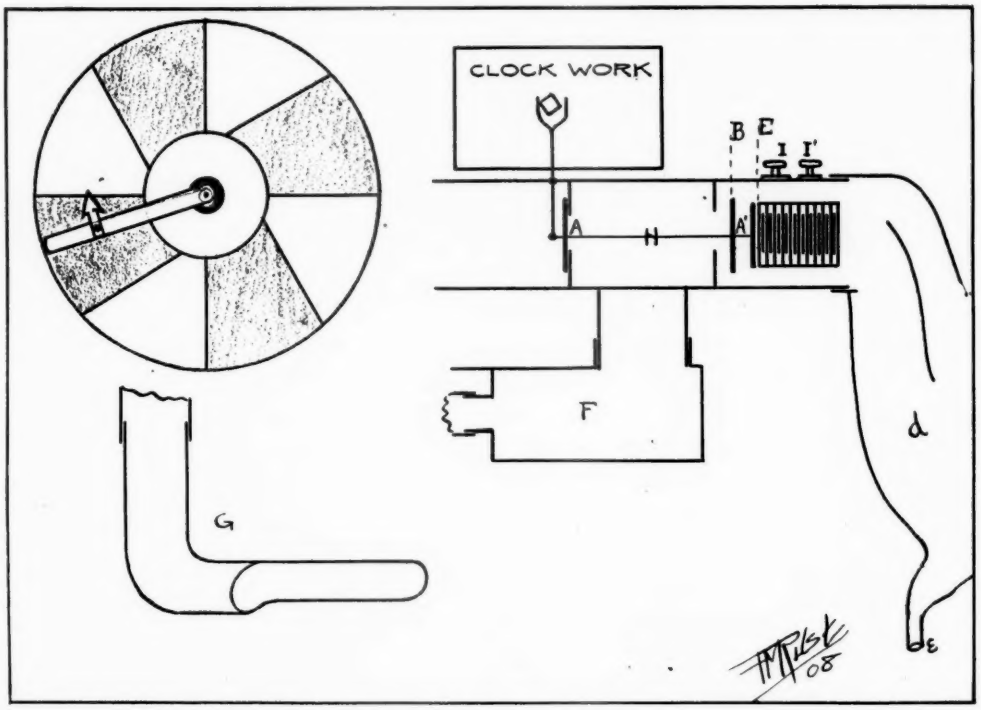
Considering the importance of the subject there has been a comparatively small amount of work done toward elaborating and developing a technic that would justify the free opening of the human thorax. Were the thorax as freely accessible as the abdomen, many of its pathological conditions would be brought at once into the surgeon's field of work.

The barrier to date has been our inability to prevent pulmonary collapse, with its attending shock. Were we able to open the chest, one or both sides, and be certain that respiration would not be embarrassed, the question of shock from manipulations would soon be settled, and the place of surgery in intrathoracic pathological conditions determined.

In this preliminary communication I wish merely to describe a mechanism that I have devised for use in intrathoracic surgical work on the human subject, and for certain other purposes to be mentioned later.

The apparatus is of the positive pressure type, is small, compact and inexpensive. As at present constructed, it delivers air to the lungs through an intubation tube, the air pressure being regulated at the will of the operator. The number of respirations per minute, and the time ratio for inspiration to expiration, that is, the proportion of each forming the respiratory cycle, are regulated at the will of the operator, but automatic after being set. The mechanism will run indefinitely, so that the duration of the operation is limited only by the usual surgical considerations. Thus I have a number of times experimented upon a dog an hour or more with the entire front and most of the sides of the chest removed. The delicacy of regulation of air pressure is such that the lungs may be kept partially inflated, or over-inflated at will. Moreover, the regulation of the rhythm is so perfect that I have been able to produce, for demonstration purposes, a Cheyne-Stokes respiration type, and maintain it at will.

Aside from its use for surgical work, it carries on artificial respiration in a way that is far superior to any device with which I am acquainted. In experimental work, again with the chest widely opened (front and sides removed) I have allowed the lungs to collapse, asphyxia with convulsions to develop, the animal finally relaxing and the heart slowing down to an occasional irregular



a and a'. Mica valves, united by cross-bar, "h", and so fitted to the valve seats that one is always open while the other is closed. *b*. A soft iron disk, attached to the projection of the bar "g" through "a." *c*. Electromagnet. *d*. An ordinary rubber gas bag, such as is used for nitrous oxide anæsthetics. *e*. Tube connecting with compressed air tank. *f*. Gauze container, for ether. *g*. Intubation tube fitted to a piece of tubing. *i*. Binding posts. Clock-work is shown attached to apparatus for actuating valves directly through a cam instead of by means of electromagnet. Face on the clock-work is shown in the upper left-hand corner. Shaded parts represent "contact" or "make"; unshaded parts, "break." A complete revolution of the contact pin makes four respiratory cycles. The rate of revolution of the contact pin determines the rate of revolution. As the contact pin is moved from the inner toward the outer circle, the time ratio of "make" to "break" (inspiration to expiration), is changed from 3 to 1, to 1 to 1.

beat, with no perceptible peripheral pulse, and revived the animal on starting up the apparatus; and repeated the experiment on the same animal at fifteen-minute intervals. It should be of material use in asphyxial conditions; asphyxia neonatorum, morphine poisoning, drowning, etc.; in profound shock and chloroform depression; in illuminating gas poisoning. There should be a wide field for its use in physiological and pharmacological laboratories.

The illustration, with the legend beneath, will serve to describe the apparatus. The electromagnet is actuated by a storage battery or street current properly cut down with a rheostat. The current is made and broken by a clock-work device in which a moving hand passes over a stationary face-piece, in such a way as to "make" and "break" the current at any rate of speed desired, and with the duration of "make" and "break" variable at the will of the operator, but automatic after being set where desired.

The illustration also shows a clock-work mechanism attached to the apparatus proper, actuating the valves by direct action, without the use of an electric current. The use of the clock-work mechanism would probably be preferred by many, is possibly less likely to get out of order, especially when use is made of it at infrequent intervals, and is necessary when electricity is not to be had conveniently. It renders the apparatus rather more cumbersome, but for all practical purposes is quite as useful as the electromagnet. While two clock-work mechanisms are figured in the illustration, but one is used, the cams actuat-

ing the valves and the device for making and breaking the current being interchangeable.

In use, the patient is intubated, the air bag "d" inflated from pressure tank, the clock-work started, and electricity turned on.

The intubation tube, constructed as shown, is easily passed, and renders the accident of vomiting of no material importance. To insure against leakage, I use an inflatable rubber bag similar to that used in the Trendelenburg tracheotomy tube.

For surgical work in which the chest is opened, I should regard the intubation tube as essential. In other cases, especially in drowning, where it may be used by non-medical men, as in government coast stations, a well-fitting face-piece may be used if desired.

I have included a receptacle for ether, and have used it in experimental work. I regard pulmonary anesthesia, however, as entirely unjustified, except in abdominal and rectal operations. In our clinical work we have found rectal anesthesia absolutely satisfactory in a sufficiently long series of cases to feel justified in making its use universal.

A NEW TECHNIQUE FOR SUTURE OF THE VAS

H. M. RICHTER, M. D.
Professor of Surgery, Chicago Post-Graduate Medical School; Assistant Professor of Surgery, Northwestern University Medical School

The successful anastomosis of the ureter, vas deferens, and Fallopian tube is materially facilitated by the reproductive capacity of their epithelial lining. It is a well-known fact that ligation of the tubes will not insure against pregnancy. Whether the ligature cuts its way through, or is ultimately absorbed, the tube that is temporarily destroyed at the site of the ligature again becomes patent, and lined with epithelium. The permanence of gall-bladder and intestinal fistulæ where the skin and mucous membranes are brought closely enough together to enable the epithelium of the two structures to reach each other, forms rather frequent illustration of the persistence with which epithelium tends to spread out and line fistulæ, making permanent tubes.

The small size of the vas deferens renders it technically difficult to make an anastomosis with any degree of accuracy of approximation. It is only through the peculiarly active regenerative capacity of its epithelium that we may expect to secure a patency of the tube.

The following technique is easily executed, and is offered after being carried out experimentally on a considerable number of animals, and upon one patient. In the neighborhood of seventy-five vasa were cut and sutured by almost as many different students, the operations taking but a few minutes each for their performance. The skiagraph is of a vas sutured seven weeks before the specimen was removed. Mercurial ointment, diluted with oil to form a rather thin emulsion, was injected into the vas, passing readily through the place of anastomosis. The specimen was then skiagraphed and showed the lumen intact.

Sections show no atrophy or other changes in the testicle, such as would be expected if the vas were occluded.

A size six or seven cambric needle is thrust, point first, into the lumen of one of the cut ends of the vas, passed up a distance of half an inch or so, and the point then forced through the wall of the vas, and grasped with a pair of hæmostatic forceps, which is then used as a handle. The eye end of the needle is then passed into the lumen of the other section of the vas, the cut ends brought together, using the needle as an internal splint. Using a fine needle, straight or curved, preferably threaded with catgut, three or four sutures unite the cut ends. The needle is then withdrawn through the wall of the vas. In our experimental work the students used cambric needles threaded with fine silk, such as they had prepared for their operations on the intestines. In my personal work I used both straight and curved needles, silk and catgut, without finding any one method to present any special advantage. I did not determine whether the sutures entered the lumen of the vas, and believe that it would be a matter of little importance whether they did or not. Likewise the forcing of the needle through the wall of vas must do comparatively little damage. I was unable to find the site in any of the several specimens that I examined, though I did not make serial sections.

In this connection I wish to report the following case in which the method was used:. It occurred in the service of my colleague, Dr. F. A. Besley, through whose courtesy I am enabled to report it.

E. R., age 31 entered Cook County Hospital Aug. 20, 1906 for the cure of an inguinal hernia. In the course of the operation the vas was accidentally cut across, and immediately sutured by the method described above. No swelling of the testicle occurred at any time after the operation during the three weeks that he remained in the hospital. We have been unable to locate him since.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

A Regular Meeting was held June 12, 1908, with the President, Dr. A. J. Ochsner, in the Chair

PRIMARY PORTAL THROMBOSIS

Report of Case and Presentation of Specimen

By DEAN D. LEWIS, M. D., and E. S. ROSENOW, M. D., Chicago

Infarction of the intestines due to thrombosis of the mesenteric veins is not so very rare as a complication of some other diseases. The most common causes of secondary thrombosis are diseases of the liver accompanied by a descending thrombosis of the portal vein, general diseases (septicæmia or cachexia), inflammatory and malignant diseases of the intestine, and thrombosis and malignant disease of the systemic venous radicles anastomosing with those of the portal system.

The case about to be reported was referred to us by Dr. Rikli. It is rare in that it is strictly speaking a primary thrombosis of the portal vein and its radicles without any preceding involvement of the liver, intestines, or the anastomosing systemic radicles, as far as could be determined by the history and autopsy.

The patient, Mr. A. B., was 38 years old. He entered the Presbyterian Hospital May 7, 1908, complaining of severe abdominal pain. The present illness began one week before with cramp-like pains in the epigastrium, but these were not severe enough to compel him to stop work, and soon disappeared. These cramp-like pains were repeated frequently and five days before entrance to hospital they became so severe that the patient was compelled to go to bed. A stomach tube was passed and the contents of the stomach were removed for relief and examination of the stomach contents. The pains increased in severity, radiated to back, and morphine was required. No vomiting associated with the pain. Bowels moved freely when cathartics were administered.

Patient had been in fairly good health up to the time of this attack, although he had not recovered his usual health since an attack of pneumonia five months before.

When admitted to the hospital it was thought that it might be possible that the patient had a gastric ulcer which had perforated. This, however, could be excluded by the previous history and the physical findings. At the time of the examination there was a leukocytosis of 21,600. A physical examination revealed considerable distension of the abdomen, abdominal tenderness, most marked over the epigastrium, and considerable rigidity of the abdominal wall. The patient seemed to be suffering intense, cramp-like pains. The findings were not positive enough at the time the patient was examined in the morning to warrant surgical interference.

The patient was seen again early in the evening. He still complained of severe pain and abdominal distress and had commenced to regurgitate frequently for the first time. The pulse became rapid and the temperature, which was 100.4° at the time of admission, remained about the same. His general condition had become worse and presented at this time much the same appearance as a patient suffering with acute pancreatitis.

It was decided that an exploratory laparotomy should be performed. The incision was made in the epigastrium; a median incision being employed, because the greatest tenderness was in this region.

Upon opening the parietal peritoneum an infarcted loop of the jejunum, about two feet in length, was found passing from above and to the left downward and to the right. As there was no evidence of volvulus or mechanical obstruction a diagonsis of thrombosis of the superior mesenteric artery was made, as a systolic murmur had been found over the aortic area. The infarcted loop of jejunum was resected and an end to end anastomosis made. The anastomosis was rendered difficult by the œdema of the intestinal mucous membrane and of the mesentery.

The patient passed into shock after the operation and died about 14 hours afterward.

It is interesting to note that the duodenum was

not infarcted in this case, although the veins draining it were involved. It is probable that the anastomosis between the systemic veins in the "fascia of fusion" and the radicles of the portal vein is rich enough to prevent infarction when the portal radicles are closed.

POST-MORTEM REPORT.

Anatomic Diagnosis. Thrombophlebitis of the portal vein with secondary thrombosis of the superior mesenteric and splenic veins.

Gangrene of the small intestine.

Recent resection of part of jejunum.

Acute mesenteric and retroperitoneal lymphadenitis.

Acute splenic swelling.

Cloudy swelling of liver, kidneys, and myocardium.

Localized bilateral fibrous adhesive pleuritis.

Slight sclerosis of thoracic aorta.

Occlusion of the vermiform appendix.

BACTERIOLOGY

A pure culture of pneumococcus was isolated from the heart's blood and in conjunction with the bacillus coli communis from the thrombosed portion of the portal vein and its radicles.

Cultures from the pericardial fluid, mesenteric glands, and bile proved negative. The organism resembled very closely certain stains of pneumococci isolated, by one of us, from cases of endocarditis. It grew in the fibrin clot of the broth blood cultures, adhered to the surface of blood agar, grew in clumps and short chains of diplococci, was moderately susceptible to phagocytosis and possessed only a mild degree of virulence to animals,—properties which pneumococci isolated from the blood in pneumonia do not possess. The differential tests, however, proved that it belonged to the pneumococcus group.

One rabbit which was inoculated with a huge dose of this organism died three weeks later and presented upon autopsy the following findings: Acute osteomyelitis of upper jaw, adhesive and fibrinous pericarditis, a beginning mitral and aortic endocarditis and a primary descending thrombophlebitis of portal vein.

Subsequent inoculation of the organisms isolated from another rabbit which also received a large dose but died without lesions, killed by overwhelming infections.

The organism now lost the peculiar characteristics described above and resembled in every way typical pneumococci isolated from the blood in cases of lobar pneumonia.

In the light of the clinical history, the autopsy, and bacteriologic and experimental findings it would seem surely that the pneumococcus which resembles so closely those isolated from cases of endocarditis must have caused the thrombo-phlebitis in this case. Its source on the other hand isn't so clear. The view, however, that it was circulating in the patient's blood since his attack of pneumonia is supported by the peculiar modifications which it probably has undergone, and by its reversion to the normal type upon animal inoculation and by the fact that certain investigators have reported the finding of pneumococci in the blood, long after an attack of pneumonia.

DISCUSSION

DR. ARTHUR DEAN BEVAN: I want to compliment Dr. Lewis and Dr. Rosenow on the excellent work which they have done in this case. Personally, in my surgical work, I have never seen a case of this kind. Gangrene of the bowel from involvement of the blood supply is, of course, not very common, nor so exceedingly uncommon, because there are now in the literature a large number of cases reported, most of them being due either to an obstruction of the superior mesenteric artery, or the inferior mesenteric artery, or to obstruction of the superior or inferior mesenteric vein, and in many of these cases there has been some definite reason for the lesion. This case is one which comes almost out of a clear sky, without any preceding history and without any data upon which the clinician might make a diagnosis. Personally, I think it is most interesting and instructive to see how this case has been run down — a definite diagnosis established at the exploratory operation, as far as the gross picture is concerned, and then the very excellent bacteriological diagnosis that has been established by Dr. Rosenow, which I am perfectly willing to accept.

DR. E. WYLLYS ANDREWS: In connection with this interesting case of primary portal thrombosis, I recall one of thrombosis and resulting gangrene of a segment of the intestine supplied by one of the mesenteric vessels. Most of these cases have been diagnosed not before operation, but upon the operating table or at autopsy. I prided myself in one case for having made an early diagnosis of thrombosis and gangrene of the intestine. No operation was deemed possible. The patient died in a few hours and autopsy showed "circulatory ileus."

In another instance a young woman in a neighboring city presented symptoms of intense ileus, and on operating I found what I had first supposed was gangrene of the entire small intestine. Upon further exploration I found considerable normal-

looking intestine beyond the gangrenous part. I resected eleven and a half feet of the black necrosed part. That patient went through the operation well, and lived about a week thereafter. It was almost an operative recovery; but the gangrene later extended and a new crisis occurred that cost her her life.

Surgeons are now being somewhat alive to the importance of circulatory ileus, on account of a discussion we had three years ago in this association. I once saw a man with all the signs of ileus, and decided to postpone operation until he could be given normal salt solution. This was done, but did not produce the slightest effect upon his heart or pulse. There was no improvement whatever, and the patient went on and died.

My diagnosis was circulatory ileus. Autopsy showed that the patient had gangrene of some six or seven feet of the small intestine; that the intravenous saline solution had poured out through a ruptured vein in the peritoneal cavity.

GENERAL CONSIDERATION OF HERNIA

AN ILLUSTRATED DISCUSSION

BY E. WYLLYS ANDREWS, M. D., CHICAGO

DISCUSSION

DR. ALEXANDER HUGH FERGUSON: I can add very little to what Dr. Andrews has said this evening. His paper has been rather complete in principle and in practice. I was pleased with the manner in which he described the various etiological factors of hernia. In studying the production of hernia from within outwards, the infundibuliform process should be considered, and it is to-day by many physicians believed to be, the all-important factor in its production. We know, however, now, that if all the other structures external to this process were normal, hernia would be a rare disease. The transversalis fascia in hernia is also deficient, or is thinned out. It is never closed in properly to form a normal internal ring. External to this, the transversalis and the internal oblique muscles must be considered from a physiologic and an anatomic standpoint, giving a strong active and passive support to the transversalis fascia and the peritoneum. The function of the red muscle is to contract during intraabdominal pressure, and prevents protrusion from within the abdomen. There is a congenital deficiency of these muscles not infrequently at Poupart's ligament, and also as they form the conjoined tendon. A good deal of study has been devoted to the lower angle of the inguinal region. It makes no difference how efficiently you counteract the congenital deficiencies of a hernia in the oblique inguinal region, later on a direct hernia may develope when the conjoined tendon is deficient. I have thought the curing of an oblique inguinal hernia in these cases rather predisposes to the production of a direct hernia inasmuch as the intraabdominal pressure is thereafter directed upon the weaker point which then is in Hesselbach's triangle.

The imbrication method, which has been so beautifully described by Dr. Andrews, and which he can use either below the cord or above it, is most commendable. I am pleased to notice that he is increasing his number of cases, if I recollect properly, of sewing everything in front of the cord. My attention was first called to the overlapping or imbrication of structures by Macewen, of Glasgow, who in his operation restored these structures to their normal position by taking one large mattress suture, going through the conjoined tendon, and putting the two ends through Poupart's ligament which overlapped the parts when the ligature was tied. Then, in a paper in 1895, I made reference to the overlapping method by saying that it is often necessary to put a few retention sutures along the edge of the overlapped structures to keep them coapted. I saw nothing of it in the literature until I noticed a paper by Dr. Andrews later in the same year which brought out the beauty of overlapping, in all cases where there is a redundancy and stretching of the aponeurosis of the external oblique. There is no doubt but that his method strengthens the inguinal region. I am firmly of the opinion that the cord should never be raised out of its bed for the cure of an oblique inguinal hernia except in connection with a retention of the testicle. I have, for a number of years, instead of cutting the vessels as Dr. Bevan recommends in some cases of this nature, tied off the deep epigastric vessel, and allowed the cord to recede very much after the manner recommended by Fowler, not, however, having the cord intraperitoneal, but keeping it extraperitoneal. The vas deferens, and the vessels will then allow the testicle to descend into the scrotum after, of course, all fibrous structures holding it back are severed.

DR. ARTHUR DEAN BEVAN: I would like to correct one point with regard to the operation that has been referred to as having been done by me for undescended testicle. I am afraid the inference will be drawn by Dr. Ferguson and others that I advocate cutting off the spermatic vessels in these cases of undescended testicle. We only do that in one case out of ten. That is not the operation at all. It is done only in those cases in which it is impossible to bring down the testicle without dividing the spermatic vessels. On Monday last we had a case of undescended testicle, right side, well below the external ring, and in that instance we could easily bring the testicle down without dividing the vessel or vessels. On the left side however, the testicle was in the abdomen, and had never been out of the abdomen, and it was necessary to introduce the finger into the abdomen and hook that testicle out. In that case the vessels had to be divided in order to bring the testicle into position.

I have been interested in Dr. Andrews' presentation of this subject. There are two things which have particularly interested me in hernia within the last few years. One is the work of Russell, of Australia. I presume most of you are familiar with his work, but I was not until comparatively recently. Russell takes the position that in hernia the all-important factor is the congenital sac; that in a large number of herniæ there is a preexisting sac, not in the sense of the technical type of congenital hernia, but that in a large proportion of instances careful dissection will show that the hernia simply pushes its way into the preexisting sac, and then enlarges that sac. There are some interesting points in support of this theory. For instance, within a few months a very interesting article appeared in the British Medical Journal, in which one surgeon made dissections in two hundred post-mortems to determine this point in cases where there was no hernia, and found in forty per cent of the post-mortems careful dissection showed a distinct hernial sac. In some of the cases there were several hernial sacs, as, for instance, in connection with femoral hernia. Most of us have been accustomed to regard femoral hernia as never being of congenital origin. Some of these dissections showed there was not only a single preexisting sac in the femoral region, but that there were three, one in each position of the femoral ring, one over the vein, and one over the artery. I have been following this matter up since reading an account of Russell's work, and am sure there is a great deal of truth in the position of Russell, namely, that we have in a large number of cases a preexisting hernial sac, and that the hernial sac is the first and most important factor in the production of hernia. The second point is the one Dr. Ferguson has taken up and beautifully illustrated. He referred to the red muscle, the internal oblique, and transversalis. In the case of undescended testicle which we saw Monday, on the left side, the side in which the testicle was never out of the abdomen, there was a large peritoneal pouch, which extended down to the bottom of the scrotum, and that pouch was sufficiently large to admit of the introduction of two fingers, and there has never been a hernia. Why? Because there was a big red muscle supplied all the way around in front of the sac, and whenever that man coughed or strained, this red muscle contracted and held the sac absolutely closed. It was a beautiful demonstration. I have never seen a more beautiful demonstration of the muscular element in hernia than in this case.

Recently, we have had several recurrences, and we have tried to explain them, and we believe we have run across an interesting explanation in the case of an old man upon whom I operated in the clinic. I know absolutely I removed the sac on the right side, ligated it off, and sewed up the canal; yet within two weeks he had a hernia in the same place. He was a very good patient and did not lose faith in me entirely, and submitted to a second operation. I operated, and much to my surprise I found exactly the same sized sac in exactly the same place. I could not understand that. It set me to thinking about it and the other day we found a possible explanation. We operated upon this case and found a fairly good-sized sac in front of the cord. I opened that up, separated it from the cord, lifted it up, split it open, looked at it, and in looking at the cord I found another sac alongside of it. There were two sacs with a common opening like a pair of pantaloons, and the common opening ran almost up to the internal ring, and I am quite sure I ligated off one sac and left the other. I simply mention this as an interesting factor.

One further point, and that is this: I think Dr. Ferguson's idea about the muscle is all right, but he is all wrong if he applies that method to a direct hernia, as the Bassini operation is much better.

DR. D. W. GRAHAM: While the operation for undescended testicle is not the subject before the Society, still, as it has been mentioned, I want to throw out this suggestion. Take those cases where the cord is short and the testicle can not be brought down, in which Dr. Bevan exsects the veins; if we will strip off the fascia, the remnants of the tunica vaginalis and all the connective tissue

thoroughly from the spermatic veins the testicle will come down as far as the vas deferens will allow it without over-stretching the veins. I have practised that a number of times with perfect satisfaction. I am not sure that this can be done in every instance, but I believe it can.

With regard to the question of hernia, I am glad Dr. Andrews referred to the arching fibers of the internal oblique and transversalis that arise from Poupart's ligament as red fibers. They do not become tendinous until at the very point of insertion, although in the usual description of operation for hernia they are called conjoined tendon. Dr. Ferguson, in his remarks, said he thought that the operation for indirect inguinal hernia predisposed to the formation of a direct inguinal hernia. My explanation of that is that there is careless work done at this point just above the crest of the pubis. Where does a hernia *begin* to come out in a recurrence after a radical operation? I have been interested in this point for a long time. I have watched every recurrent case carefully that I have had, either in my own practice or that of my colleagues, and never saw one in which the hernia did not first appear at the internal ring with the cord, or just above the pubic crest behind the external ring, or at its termination, in our operations. I think it makes little difference how we treat the structures between these two points, that is, those pertaining to the canal itself, provided we do thorough work at the two most vulnerable points.

Dr. Daniel N. Eisendrath: I have followed Dr. Andrews' work for a number of years, and have performed a considerable number of operations according to his method, so that I have had a chance to see a great many of his cases and my own.

I believe there are certain points in the anatomy of inguinal hernia which should be emphasized. Dr. Ferguson has advanced the same argument concerning this one point which Dr. Graham has referred to, and it is one of the factors which predisposes to the formation of a hernia, namely, the extent of the attachment of the internal oblique and transversalis to Poupart's ligament. Dr. Ferguson, in a paper published in 1899, in which he first brought out his posterior operation, made the point that the internal oblique and the transversalis began to leave Poupart's ligament at the outer third, as a rule, in his experience. Now, there may be some misunderstanding in either our own minds or that of Dr. Ferguson as to what can be called the conjoined tendon. The fibers which leave Poupart's ligament at its middle are called the arching fibers of the internal oblique and transversalis; they are not called the conjoined tendon until they begin to unite and to be inserted into the symphysis pubis in front of the rectus muscle, where they form a portion of the posterior wall of the external ring, giving it additional support. The point Dr. Ferguson has made as to the cause of many hernias was that this point of attachment was only to the outer third of Poupart's ligament. I began to observe in a considerable number of patients, during life, and also examined a considerable number of cadavers, and found that almost uniformly in the male, the fibers of the internal oblique and transversalis began to arch from the outer half of Poupart's ligament. These arching fibers leave Poupart's ligament at the outer half, and begin to arch over to form the conjoined tendon. In the female it is different. The arching fibers extend and are attached to the outer two-thirds of Poupart's ligament, not to the outer half, as in the male. This is perhaps a small anatomical difference, but I think the condition of attachment to the outer third of Poupart's ligament is not as frequent as Dr. Ferguson thinks.

TRANSACTIONS OF THE AMERICAN ASSOCIATION OF OBSTETRICIANS AND GYNECOLOGISTS

TWENTY-FIRST ANNUAL MEETING, HELD AT BALTIMORE, MARYLAND, SEPTEMBER 22, 23, AND 24, 1908. THE PRESIDENT, DR. E. GUSTAV ZINKE, OF CINCINNATI, OHIO, IN THE CHAIR.

ARTERIOSCLEROSIS OF THE UTERUS

BY CHARLES M. REES, M. D., CHARLESTON, S. C.

He noted that (1) sclerotic changes in the arterial supply to the uterus were probably of greater frequency than had generally been observed. (2) A pathological change might take place in the uterus independently of general arteriosclerosis. (3) From the frequent physiological changes to which the uterine blood supply was subjected, and the resistance offered, sclerotic changes were favored. (4) That sclerosis and even changes advanced to atheroma with calcareous deposits in the arterial walls of the uterine arteries were found localized in the uterus. (5) These changes occurred in the vast majority of child-bearing women about the menopause. (6) Arteriosclerosis of the uterus might be the cause of alarming hæmorrhages, which were uncontrollable by any of the ordinary measures, and hysterectomy was necessary to save life. (7) Hæmorrhages caused by arteriosclerosis of the uterus usually came on at the cancer period of a woman's life and could not be differentiated by any other means than hysterectomy, and microscopical examination.

He emphasized the following facts: 1. That a diagnosis of arteriosclerosis of the uterus was difficult to make, and could only be made where it was possible to exclude every other cause of hæmorrhage from the uterus, and by microscopical examination of scrapings from the uterus in which sclerosed capillaries were found, or finally from sections of such a uterus after its removal. 2. Arteriosclerosis, as a definite cause of hæmorrhage from the uterus, appearing in women between the ages of 40 and 50, and among those who had borne children, was of greater importance than had generally been determined. 3. That in a fair proportion of cases the hæmorrhages from the uterus were in themselves sufficient to endanger the life of a woman and could be made to yield only to hysterectomy. 4. That, with the uncertainty of diagnosis even after examinations of a section from the cervix and scrapings from the uterus, which showed no evidence of malignancy in women who between the ages of 40 and 50 had borne children, and suffered with frequently recurring hæmorrhages, hysterectomy was justified.

DISCUSSION

DR. C. C. FREDERICK, of Buffalo, New York, said he had seen several cases in the past two years of persistent bleeding in which there was no great enlargement of the uterus, and there was no evidence of any fibroid growth, and likewise no evidence from the scrapings of any degenerative changes in the uterus indicative of cancer. Repeated curettement failed to control the hæmorrhage. In these cases he had done vaginal hysterectomy, and had advised that the operation be done by the clamp method. The operation might be done through the abdomen, but preferably through the vagina as it was a much easier and shorter operation by this route. There was likewise less shock. When the uterus was not enlarged he advised always that the operation be done through the vagina with the clamp.

DR. HUGO O. PANTZER, of Indianapolis, Indiana, said that the localized occurrence of sclerosis of the uterine arteries was described by Virchow in connection with the case of a woman who had had but one pregnancy, and involution was followed by the usual changes. The frequency of this affection was much greater than was commonly believed, and there was no doubt that many of these patients could be relieved by operation. He recalled one patient who would not submit to operation, and after profuse hæmorrhages she got well. In operating he invariably preferred the abdominal route, but not by the clamp method.

DR. FREDERICK BLUME, of Pittsburgh, Pa., confirmed what Dr. Frederick said with reference to the removal of the uterus in these cases through the vagina. He had operated on three cases of arteriosclerosis of the uterus by the vaginal route by the clamp method in the last two years.

DR. JOHN A. LYONS, of Chicago, reported a case of arteriosclerosis of the uterus in which hysterectomy had been recommended by others, but he succeeded in relieving the patient by electricity, using forty milliamperes for from five to ten minutes at a time, the duration of the treat-

ment extending over a month or more, at the end of which time the hæmorrhage ceased.

DR. CHARLES G. CUMSTON, of Boston, said that some years ago he read a paper entitled "Hæmorrhagic Metritis," and in it he gave the pathological findings which were chiefly arteriosclerosis of the small vessels of the uterine parenchyma, likewise considerable sclerosis of the uterus. He advised and practised at the time vaginal hysterectomy, but was vigorously sat on as being too radical. Since that time he had had several cases in which he found the uterus somewhat enlarged, movable, with apparently no lesion in the adnexia, and had operated purely for uncontrollable hæmorrhage. Repeated curettement was insufficient. If the uterine hæmorrhage continued in these cases after regeneration of the endometrium, he believed the proper procedure was to perform vaginal, and not abdominal, hysterectomy.

DR. ALBERT GOLDSPOHN, of Chicago, called attention to the difficulty of making a diagnosis in cases of arteriosclerosis of the uterus, consequently there was danger of treating some cases under a mistaken diagnosis. Actual cases of arteriosclerosis of the uterus should betreated by hysterectomy, and nothing else. In connection with the vaginal operation he highly recommended the use of the Downes electric angiotribe or clamp.

HYSTERIA AS THE SURGEON SEES IT

BY AP MORGAN VANCE, M.D., LOUISVILLE, KY.

A number of instances of hysteria simulating grave organic lesions were related. He spoke of the methods of cure which he attributed to the power of suggestion and an attitude of command as the controlling elements in vanquishing the obsession of the victims. He suggested the necessity of alertness to avoid misdiagnosis, and attributed his quick and certain success in diagnosis and treatment of some of these cases to that alertness bred of the rivalry in diagnosis which came within his fortunate experience early in his medical career.

DISCUSSION

DR. HERMAN E. HAYD, of Buffalo, emphasized the difficulty attending a correct diagnosis in cases of hysteria. Everyone had seen patients who had been sadly neglected, and who had been treated for all kinds of hysterical symptoms, when there was really not only one pathological condition at the bottom of them, but various pathological conditions, making the case extremely complex; therefore, the reason why so many of these neurasthenic, hysterical, and neurotic women were not cured was not because they had not received good surgery, but because they had not had enough good surgery.

DR. CHARLES G. CUMSTON, of Boston, had found that the quickest way to make hysterical patients walk, who thought they had hip-joint disease, was to mention in there presence that high amputation was the proper thing, and in a case he recalled the patient was able to walk in a short time afterward. He related the case of a woman who was supposed to have had hip-joint disease, such a diagnosis having been made by an orthopedic surgeon. A pelvic examination disclosed hydrosalpinx, and upon its removal the hip-joint symptoms disappeared.

DR. JOHN A. LYONS, of Chicago, took issue with Dr. Hayd that there was always marked pathology in these hysterical patients, and supported the views advanced by the author of the paper. He believed that in many instances the hysteria could be relieved by suggestion, and cited at length a case that came under his own observation in support of it.

DR. ROLAND E. SKEEL, of Cleveland, said the welfare of the medical profession and its patients depended on recognizing the fact that there were two factors in many cases, namely, that while there might be minor pathology, it was only recognized by the patients themselves by reason of over-excitable and over-sensitive nerves, and that physicians really overlooked these two factors. These minor pathological conditions could be found if they were sought for, and inasmuch as there was no perfect human body, even if the pathology were removed it would only cure a limited number of patients. He referred to the many reflex troubles that might arise from minor pathological conditions, and reported cases.

COMPARATIVE MERITS OF ABDOMINAL CŒLIOTOMY IN THE TREATMENT OF INTRAPELVIC ABSCESS

By W. S. SMITH, M. D., Baltimore, Maryland

It was stated that if one considered the improvements that had been made in surgical technique, together with the striking results obtained in pus cases by the Fowler postural treatment and the Murphy irrigation, the mortality plea lost much of its significance and force. Recent experience in this connection on the part of the author has been instructive and satisfactory. In the last 110 laparotomies which he had done, there had been no mortality. Of this number, 53 were performed for intrapelvic pus. Drainage was indicated and used in 10 instances, and the Fowler-Murphy treatment was resorted to twice. During the same period of time there had been but 10 colpotomies, and 2 of these were followed by the abdominal operation.

DISCUSSION

Dr. Charles L. Bonifield, of Cincinnati, said that vaginal incision was of great importance in selected cases, and the earlier one could get at pus behind the uterus and drain it, the less damage there would be done to the uterine appendages, and the more hope there was of curing these patients without a radical operation. Under the most favorable circumstances it was the exception rather than the rule that these patients were cured by this simple procedure. To deal with these cases by the vaginal route, if the temperature had become normal, and the patient was in a condition to withstand radical operation, was to attack the disease in an awkward and inefficient way. The mortality from operations for pus in the pelvis depended very greatly on when the operation was done. One should avoid abdominal section for the removal of suppurating appendages while the patient had elevation of temperature. Personally, he had almost completely given up conservative surgery in cases of inflammatory disease of the appendages. Conservative surgery as regards the tubes was more frequently successful than that with regard to the ovaries. In cases in which he had left part of an ovary, the patients usually returned for a subsequent operation.

Dr. Albert Goldspohn, of Chicago, said that vaginal drainage was permissible in acute pelvic conditions, and the cases amenable to this operation were those in which the focus of pus was located in the pelvic cellular tissue — a parametritis. Where the primary focus of inflammation was not intraperitoneal nor intratubal, but was in the pelvic cellular tissue, great relief was afforded or even a cure sometimes effected by vaginal drainage. Intraperitoneal suppurative conditions were not usually benefited very much by vaginal drainage, but more radical measures were needed.

Dr. C. C. Frederick, of Buffalo, said that in pelvic abscess he preferred the vaginal route for drainage, and then, if necessary, a more radical operation could be done at a later time.

Dr. Frederick Blume, of Pittsburgh, said he had resorted to vaginal incision and drainage in the cases under discussion, and later, if the patient returned, he performed an abdominal operation. Where the uterus was veritably riddled with small abscesses, even though one removed the uterus, the patient was usually so generally infected that operation was likely to be followed by an unfavorable result.

Dr. Joseph A. Hall, of Cincinnati, said that many pelvic abscesses were the result of tuberculosis, and many of these abscesses were caused by the gonococcus. Vaginal section accomplished much good in some of these cases, but in others more radical operative measures were indicated.

Dr. Louis Frank, of Louisville, said there could be no question as to the advisability of vaginal incision and drainage in acute pus collections as a temporary expedient. His experience, however, was that in some cases in which it was done abdominal section was required later. In one case there was a pus collection between the bladder and the uterus in which the fever continued unduly high after vaginal colpotomy. Cases of infection of the tubes and broad ligament which did not subside after opening the abscesses yielded only to extirpation of the tube and the removal of the broad ligament.

Dr. Joseph H. Branham, of Baltimore, called attention to the virulence of infection, saying that in some cases the degree of virulence was slight, while in others it was great, and that the treatment should vary accordingly.

Dr. Smith, in closing the discussion, said he had not been convinced of the importance of removing a healthy tube, even though the infection was of gonorrhœal origin. He thought that a thorough curettement of the uterus and careful exsection of the diseased tube would result in a permanent cure, and there was seldom any necessity for taking out a healthy tube.

SYMPOSIUM: EXTRAUTERINE PREGNANCY

EXTRAUTERINE PREGNANCY. Herman E. Hayd, M. D., Buffalo, New York.
ADVANCED ECTOPIC GESTATION, WITH LIVING CHILD, WITH REPORT OF THREE CASES. X. O. Werder, M. D., Pittsburgh, Pennsylvania.
ECTOPIC GESTATION. Charles L. Bonifield, M. D., Cincinnati, Ohio.

EXTRAUTERINE PREGNANCY

DR. HERMAN E. HAYD, of Buffalo, New York, classified his cases according to their clinical manifestations: (1) The tragic or cataclysmic class, where there was free hæmorrhage going on into the peritoneal cavity, with no tendency to localization. Here an immediate abdominal operation was recommended. (2) The cases where a small rupture had taken place and where hæmatocele more or less circumscribed developed. In this class vaginal incision and drainage were advised, if the pregnancy was not advanced beyond the sixth week, or if the blood-clot had not become too firmly organized. (3) Those cases which had gone on to the second and on to the fourth or fifth month, when rupture took place, but the fœtal product continued to grow on account of the new attachment it made. (4) Those cases which had gone on to the development of a pelvic abscess with broken-down fœtal products in the mass. (5) Those cases which had gone on to term and were delivered by operation when the child was viable, or where the child had died and undergone mummification or calcification as a lithopedion.

ADVANCED ECTOPIC GESTATION, WITH LIVING CHILD, WITH REPORT OF THREE CASES

Dr. X. O. WERDER, of Pittsburgh, read a paper with this title, in which he said that all these cases began as tubal pregnancy. The time of rupture could be estimated from the history of every case. In the first case it occurred at about the end of the second month; in the second case it apparently occurred unusually late, about the middle of the fourth month; and in the third case severe cramps about six weeks after the last menstrual period indicated that rupture took place at that time, although the complication with normal pregnancy and a subsequent abortion caused the symptoms to be rather mixed and consequently less definite than in the previous cases. In none of the cases was the diagnosis attended with great difficulty. In the advanced form of extrauterine pregnancy the only other conditon with which it might be confounded was normal uterine pregnancy. Mistakes in diagnosis were less likely to occur than in the earlier forms of ectopic gestation, although even the latter cases were not usually difficult to recognize.

Having in the prophylactic instrumental compression of the abdominal aorta a safe and reliable means to prevent the so much dreaded placental hæmorrhage, which had really been the principal stumbling-block in the surgical treatment of advanced ectopic gestation, there seemed to be no longer any just ground for other than radical operation in this condition, consisting in the complete extirpation of the gestation sac with living placenta, an operation which in his opinion was the only proper and correct surgical procedure for these cases.

ECTOPIC GESTATION

DR. CHARLES L. BONIFIELD, of Cincinnati, divided cases of tubal pregnancy into five classes. *First*, those in which a slight hæmorrhage occurred at an early period, six to eight weeks, and killed the ovum. Such an ovum with the blood-clot might be absorbed and the patient regain her health. He reported a case representing this class. *Second*, those in which the rupture occurred a little later than eight to ten weeks. In these the hæmorrhage was so profuse as to cause well-marked classical symptoms, but was not so profuse as to menace at once the life of the patient. To the *third* class of cases belonged those which were in immediate danger of death from hæmorrhage. This class was not numerous, but it gave rise to practically all the argument as to the relative virtues of immediate and deferred operations. The best course to pursue in the treatment of these cases was to operate at once if the hæmorrhage was in progress when the operator saw the case, and to defer operation if it had ceased. In the *fourth* class there was a living fœtus which had developed to the sixteenth week or later. About fifteen years ago he operated on such a case at the sixth month. The child died in a few minutes, and the mother only survived twenty-four hours. Her death was due to loss of blood caused by the separation of the placenta from the intestines and omentum, to which a large part of it was attached. In the *fifth* class the physician had to deal with a dead fœtus which had attained an advanced stage of development. The death of the fœtus rendered the operation safer for the mother, provided it was not undertaken until a sufficient time had elapsed for a change to take place in the placenta.

DISCUSSION

Dr. Albert Goldspohn did not think that all cases of extrauterine pregnancy should be operated on at once. Cases of tubal abortion, in which the ovum slipped out of a somewhat dilated abdominal end of the tube, did not bleed very much, nor did they produce profound shock. The natural course was for the hæmorrhage to stop by the formation of a hæmatoma to a limited degree, and there was no danger to life, either immediate or remote. Operation was usually advised in case invalidism resulted more or less from the cicatricial mass of coagulated blood that would not be entirely absorbed, which would usually form an entanglement about the ovary, a disease which would require operation later. When hæmorrhage was stopped and the hæmatoma was accessible, it could be emptied by the vagina if one made the proper incision for vaginal drainage. On the other hand, it was not safe to assume that in ruptured tubal pregnancy hæmorrhage was going to stop, hence it was necessary to operate.

Dr. C. C. Frederick had operated 133 times for ruptured ectopic pregnancy. There were cases of tubal abortion where the amount of hæmorrhage was so small and finally ceased that eventually the women got well without operation.

Dr. Henry Schwarz, of St. Louis, said there were several cases on record in which women with tubal pregnancy went to term. He had himself operated on such a case. The sac was removed in its entirety, disclosing a mature macerated male fœtus above the average weight.

Dr. A. B. Miller, of Syracuse, said that no one could lay down any law which would guide the ordinary practitioner as to the time for operation as he came in contact with these cases. Some patients with ruptured extrauterine pregnancy undoubtedly might have had their lives saved if they had been operated on immediately.

Dr. Walter B. Chase, of Brooklyn, said that every case must be a law unto itself as to whether to operate or not.

Dr. Miles F. Porter, of Fort Wayne, Indiana, said that if a surgeon were called to see a man or woman with a history that he or she had received a stab wound in the neck and had symptoms of bleeding to death, naturally he would search for and tie the bleeding vessel. This was the thing to do in a case of ruptured ectopic pregnancy in which hæmorrhage was going on. If one could tell when hæmorrhage had ceased, he could wait, but who could tell this?

Dr. Thomas B. Noble, of Indianapolis, Indiana, believed in the doctrine and preached the philosophy of an immediate operation in cases of ruptured extrauterine pregnancy, for the reason that if the information went out that these cases were to be treated by procrastination until the diagnosis was certain, these patients would be tinkered with by general practitioners, and the specialist would only be called in to sign a death certificate.

Dr. Frederick Blume emphasized the importance of differentiating what cases should be operated on and which should be left alone.

MISCELLANEOUS REPORTS

A Simple, Certain, and Universally Applicable Method of Preventing the Serious Accident of Leaving a Sponge in the Abdomen. H. S. Crossen, M. D., St. Louis, Missouri.

Mobility of the Patient after Laparotomy. Walter B. Chase, M. D., Brooklyn, New York.

Acute Pancreatitis. Louis Frank, M. D., Louisville, Kentucky.

Abscess of Gartner's Canal. Magnus A. Tate, M. D., Cincinnati, Ohio.

Caesarean Section. C. C. Frederick, M. D., Buffalo, New York.

The Development of the Human Ovum during the first Eight Weeks of Pregnancy. Henry Schwarz, M. D., St. Louis, Missouri.

President's Address, Solving the Problem of Obstetrics. E. Gustav Zinke, M. D., Chicago, Illinois.

Intraligamentous Fibroids. John F. Erdmann, M. D., New York.

Uterine Fibroids Complicating Pregnancy. William J. Gillette, M. D., Toledo, Ohio.

Myoma of the Cervix Uteri. Francis Reder, M. D., St. Louis, Missouri.

Ovarian Cystoma Complicating Pregnancy. Charles G. Cumston, M. D., St. Louis, Missouri.

Subdiaphragmatic Abscess. John W. Keefe, M. D., Providence, Rhode Island.

Injuries to the Bladder taking place during Hernia Operations. Roland E. Skeel, M. D., Cleveland, Ohio.

Surgery of the Spleen with Special Reference to Trauma — A Method of Incapsulation. Walter G. G. Kirchner, M. D., St. Louis, Missouri.

Treatment of Typhoid Fever Perforation. John D. S. Davis, M. D., Birmingham, Alabama.

SOME OLD FALLACIES IN RETROVERSION SURGERY REVIVED. Albert Goldspohn, M. D., Chicago, Illinois.
TYPHLITIS. John A. Lyons, M. D., Chicago, Illinois.
REPAIR RATHER THAN REMOVAL OF THE GENERATIVE ORGANS OF WOMEN. John E. Cannady, M. D., Charleston, West Virginia.
EXPERIMENTS UPON ANIMALS RELATIVE TO THE QUESTION OF ABDOMINAL SUPPORTERS AFTER LAPAROTOMY. Robert T. Morris, M. D., New York.

A SIMPLE, CERTAIN, AND UNIVERSALLY APPLICABLE METHOD OF PREVENTING THE SERIOUS ACCIDENT OF LEAVING A SPONGE IN THE ABDOMEN

DR. H. S. CROSSEN, of St. Louis, Mo., said that security against this fatal accident was counted one of the unsolved problems of abdominal surgery. Practically all authorities stated that there was no guarantee against its occurrence, even in routine hospital work, and with all the rules of co-operation and the cumbersome apparatus devised to prevent it. The failure of the preventive methods in general use was due to their dependence on sustained attention concerning the sponges, which attention could not be given by the operator, it being required elsewhere. A method to be effective under all circumstances must be practically automatic, must be applicable in emergency work in the country as well as in hospital work, and should be fairly convenient. Such was the method he had used during the past two years. It insured the removal of all gauze without particular attention on the part of anyone. It consisted in the elimination of all detached pads and sponges and the utilization of ten-yard gauze strips, each strip packed in a convenient bag in such a way that it might be drawn out a little at a time, as needed.

MOBILITY OF THE PATIENT AFTER LAPAROTOMY

DR. WALTER B. CHASE, of Brooklyn, New York, contributed a paper on this subject, in which he stated that (1) the early dictum of the rigid immobility of the patient after laparotomy — yet too much in vogue — was wrong in principle and injurious in practice. (2) Limited mobility of the patient, active or passive, within rational limitations, was admissible and desirable whenever the comfort and advantage of the patient were thereby promoted. (3) The cardinal prerequisites to prompt healing of wounds were perfect coaptation, perfect rest, and freedom from infection. (4) The sitting up of the patient in bed or out of bed the day after the operation, being around the ward the following day, and leaving the hospital for ordinary exercise at the end of a week, was not compatible with sound surgical procedure, even though, in individual instances, satisfactory recovery had followed. (5) By ignoring the pathological conditions present, the burden of proof, that the phlebitis was not due to infection, or that the mischief attending thrombosis and embolism was not a result of too early mobility of the patient, rested with the advocates of the new departure.

DISCUSSION

DR. ALBERT GOLDSPOHN, of Chicago, said it was wrong to encourage patients to get up on the second or third day after laparotomy, as it was necessary to wait until cicatrization was fairly complete, and this did not occur in less than about ten days.

DR. DANIEL H. CRAIG, of Boston, stated that the mobility of a patient after operation had a relationship to the post-operative complications of phlebitis and thrombosis, and he believed that early mobility of patients lessened the liability to these complications.

ACUTE PANCREATITIS

DR. LOUIS FRANK, of Louisville, said that pancreatic disease until recent years had been very much neglected, and referred to the growing importance of its study. Pancreatic diseases were not all incurable. He referred to the anatomical and etiological factors concerned. He laid stress on the necessity of early recognition. After describing the symptoms he spoke of the treatment as being surgical, and in order to be effective it must be prompt. He reported three cases on which he had operated.

ABSCESS OF GARTNER'S CANAL

DR. MAGNUS A. TATE, of Cincinnati, spoke of the rarity of this condition, and reviewed the literature of the subject. He reported the following case: Patient 36 years of age; normal weight 135 pounds. Married 15 years; had never been pregnant, and had never been unwell. Had never had any discharge of a bloody character from the vagina, and never had had any of the other symptoms which often accompany a menstrual discharge. For some years she had had a number of very peculiar attacks, never knowing what caused them, nor had she ever had any satisfactory causative explanation. The trouble began with a pain in the pelvic region accompanied by rigors, this being followed by distinct chills, rapid pulse, and high temperature. This would last

from a few days to a week or two, then there would be a vaginal discharge of a little pus, which was always followed by a subsidence of symptoms, and an apparent recovery would ensue. Patient would then get up, go about her household duties, and be free from another spell from six months to a year, when she would be attacked by a similar sickness. She was somewhat emaciated, only weighing about 100 pounds, was very feeble, her temperature ranging from 102° to 104°, and pulse 120 to 130. Upon abdominal examination there was some tenderness elicited over both the right and left lower sides of the pelvis. Vaginal examination was very painful, and patient said there had been for a few days a slight watery flow mixed with a little pus; vagina very hot and exquisitely tender, so that an unsatisfactory examination was made. Patient consented to going to hospital. After complete anæsthesia a vaginal examination disclosed a small anteverted uterus, but no tubes or ovaries could be palpated. On the right wall at a central point between the anterior and posterior vaginal walls was found a decided thickening, and on tracing it up it felt like a ridge of massed tissue, which passed up to the side of the cervix in the vaginal vault. Being still at a loss to account for symptoms, he opened the posterior cul-de-sac, and on careful palpation thought he detected a small fluctuating mass in the right broad ligament, but no ovaries or tubes were present to the examining finger. After packing some gauze in the back of the uterus he opened up this ridge of vaginal ligament as far as he could. He thought best at this time to stop hunting and make an abdominal section later if the woman's condition would allow it. The following day the gauze which had been placed in ridge tissue was bathed in pus which was constantly being discharged. The temperature subsided and patient recovered. For nine months her health had been excellent; no pain or tenderness; no vaginal discharge; she had gained her usual weight, and was normal except for the absence of the menstrual flow.

CÆSAREAN SECTION

Dr. C. C. Frederick, of Buffalo, gave a résumé of the present status of this operation, and said that until within recent years it was appealed to only as a last resort in obstetrical delivery. The operation now was as safe as any other abdominal operation, if done early. The consensus of opinion was becoming favorable to Cæsarean section as being preferable in contracted or deformed pelves, to protracted high forceps operation, version, symphyseotomy or pubiotomy. Was it not preferable also to accouchement forcé in severe uræmic convulsions or in placenta previa with central implantation?

THE DEVELOPMENT OF THE HUMAN OVUM DURING THE FIRST EIGHT WEEKS OF PREGNANCY

Dr. Henry Schwarz, of St. Louis, Missouri, called attention to the fact that all text-books of obstetrics described the ovum and fœtus at the end of ten periods of twenty-eight days each, and they all, without exception, declared the ovum to be of the size of a pigeon's egg, and the fœtus of a length of 7 to 19 millimeters at the end of the first lunar month, that is to say, before the woman's menstruation was overdue. The fact was, the youngest ovum on record, that of Peter, which was the size of a hemp seed, was found when menstruation was three days overdue, and belonged therefore, to the middle of the fifth week of pregnancy, or to the beginning of the second lunar month. At the end of the first lunar month the ovum was still a very small body, and passed through the uterine end of the tube just about the time when menstruation became overdue. All ova varying in size from a millet seed to a hen's egg belonged to the second lunar month, and their description had to be rearranged.

Dr. Schwarz believed and had taught for twenty-five years that ovulation as a rule, preceded menstruation, and that the impregnated ovum dated from the first menstrual period which had been suppressed; that during the first lunar month of our present counting, pregnancy existed only during the last few days, and that during these days the ovum migrated through the tubes without noticeable increase in size, reaching the uterine cavity about the day of the expected menstruation, and there casting off its shell of zona pellucida, as demonstrated by Spee for the ovum of the guinea-pig.

PRESIDENT'S ADDRESS: SOLVING THE PROBLEM OF OBSTETRICS

The President, Dr. E. Gustav Zinke, of Cincinnati, reviewed at length some of the important events in medicine and surgery of the last one hundred years. He compared the old and new methods of managing the pregnant, parturient, and puerperal states. Reference was made to the changes in the practice of midwifery within the last fifty years. There was practically no improvement in the maternal and fœtal mortality and morbidity of midwifery during the last twenty years. The present rate of obstetric mortality followed immediately that of tuberculosis. Eclampsia, placenta previa, oblique and transverse presentations, narrow and contracted pelves, were

conditions which precipitated in every instance a conflict unto death between mother and child. The problem of preventing this conflict was gradually being solved by the aid of anæsthesia, antisepsis, asepsis, the forceps, symphyseotomy, pubiotomy, hebosteotomy, and Cæsarean section. The gradual elimination of the induction of premature labor, prophylactic version, the high forceps, and perforation of the living child had begun. The problem of obstetrics would be solved when the custom of sending the pregnant and parturient women—victims of complications—to a maternity had become an established practice.

INTRALIGAMENTOUS FIBROIDS

Dr. John F. Erdmann, of New York, said that during the past seven years he had operated upon 61 cases of fibroids, doing 48 hysterectomies, and 13 myomectomies. Of this entire number he met with 5 cases of intraligamentous fibroids, one of which was a case of multiple fibroids of the uterus, with two discrete ones in the right broad ligament. The remaining four were true intraligamentous fibroids in the full sense of the word. None of these intraligamentous masses in any of the five cases had any association with the uterus, except one, in which the association was due to an inflammation occurring in the pelvis, and an exudative or plastic adhesion to the uterus was evident. In four of these cases the tumors were hard or of the same consistency as ordinary fibroids. In the large round one the feeling was of a decidedly soft nature. The author reported the five cases in detail, with recovery in all of them.

UTERINE FIBROIDS COMPLICATING PREGNANCY

Dr. William J. Gillette, of Toledo, Ohio, read a paper on this subject in which he reported cases. The points he desired to bring out were, in the presence of a pregnancy, should (1) operations for the removal of fibroids be limited to the fifth month, and if not, and limited to any time, what should that time be? (2) That not only pedunculated and subperitoneal tumors might be removed, but interstitial as well, without the interruption of pregnancy. (3) That even very small fibroids may be so situated as to become of lethal significance. (4) That fibroid tumors might practically disappear at this time or shortly subsequent to it. (5) The possibility of the removal of pedunculated fibroids during labor, allowing it to progress naturally.

MYOMA OF THE CERVIX UTERI

Dr. Francis Reder, of St. Louis, made some remarks on this subject and reported cases.

OVARIAN CYSTOMA COMPLICATING PREGNANCY

Dr. Charles G. Cumston, of Boston, Mass., said that the indication for operative interference during pregnancy was usually the severity of the symptoms. The cyst should be removed by abdominal incision or posterior colpotomy, according to the situation and size of the neoplasm. Cooling of the abdominal cavity was to be avoided during operation, as it was an important factor in the production of premature labor. The favorable results obtained when operation was done during the first few months of pregnancy were not accidental, and a timely removal of the cyst might prevent threatened miscarriage. Operation should be advised as soon as a diagnosis of cyst had been made, in order to avoid complications due to the presenceof the tumor during pregnancy labor, or the post-partum.

SUBDIAPHRAGMATIC ABSCESS

Dr. John W. Keefe, of Providence, Rhode Island, defined an abscess of this character as a collection of pus and gas which lay in contact with some portion of the under surface of the diaphragm. It was rarely the result of a traumatism, but was generally due to some previously diseased condition. The author reported six cases, and the main facts which he emphasized were the avoidance of the transpleural route; the dangers attending the use of the aspirator needle and the unnecessary resection of the ribs; the advocacy of exploratory abdominal incision, with drainage through the same or in the tenth or eleventh interspace, in the post-axillary line.

INJURIES TO THE BLADDER TAKING PLACE DURING HERNIA OPERATIONS

Dr. Roland E. Skeel, of Cleveland, Ohio, said that since the appearance of Bruener's article in 1898 and Moynihan's in 1901, bladder herniæ were apparently increasing in frequency as shown by 144 cases collected since 1896, as compared with the 181 in the literature previous to that date. These herniæ were no more frequent than before, but present methods of operating as well as increased care in looking for them accounted for the more frequent report of such cases. The cases reported showed a large proportion not diagnosed until operation, and unfortunately a great number were not recognized until the bladder was injured, and a fair per cent were not recognized even at the time of injury. Many of these cases were artifically produced by traction upon the sac and efforts to place the ligature high up resulted in catching the bladder wall in its bite. In addition to the ordinary method of recognizing the bladder

by the appearance of the prevesical fat and the large veins on the fundus, the administration of methylen blue for a day or two previous to hernia operations would cause instant recognition of the bladder injury if it occurred. Such a routine measure was justified by the fact that the mortality rate for hernia operations was practically *nil* aside from accident.

SURGERY OF THE SPLEEN WITH SPECIAL REFERENCE TO TRAUMA — A METHOD OF ENCAPSULATION.

DR. WALTER C. G. KIRCHNER, of St. Louis, Missouri, reported twenty-two cases of injury to the spleen treated by splenectomy and other methods. After describing the various symptoms of injury to the spleen, the writer described a method of treating hæmorrhage from the spleen was by encapsulation. In this operation the spleen was brought forward and delivered into the wound as in splenectomy. Wide sutures were inserted through the spleen to approximate the fractured or cut edges, and these sutures were also used to retain the omentum which was wrapped over the spleen to form a sort of capsule. The organ was then replaced in the splenic fossa, and held in position by means of packs.

The author reported a case of gunshot wound, and two cases of rupture of the spleen treated by this method, with recovery. He emphasized the seriousness of injury of the spleen and advocated early operation. If the spleen alone was involved, and the patient's condition warranted, the method of encapsulating the spleen with omentum was advocated for the following reasons, namely: that the spleen need not necessarily be sacrificed in the control of hæmorrhage; that a portion of the spleen might be removed, and when thus treated splenectomy need not necessarily be performed; that the danger of secondary hæmorrhage was very greatly lessened, and that favorable results in suitable cases warranted a continuation of the use of the method.

TREATMENT OF TYPHOID FEVER PERFORATION

DR. JOHN D. S. DAVIS, of Birmingham, Alabama, had operated on ten cases of typhoid fever. In nine, perforations were found. Of this number, there were eight recoveries and two deaths. One typhoid case was operated on, with recovery, in which no perforation was found. Two were perforations of the ileum; one had a perforation in the ileum and at the base of the appendix; one had two perforations of the colon, ascending and transverse; four were appendicular, one of which later had a perforating anastomosis between the ascending and transverse colon. The last fatal case had two perforations in the ileum.

In the progress of typhoid perforation, the individual's physical condition, power of resistance, character and virulence of the organism in the peritoneal cavity, age of patient, time elapsing between perforation and performance of the operation, were important factors in determining the result. Perforation occurred in all grades of severity from the ambulatory to the hæmorrhagic type. It was most common in those with severe infection. It was more common in the hæmorrhagic than in the mild cases. It was frequent in the so-called ambulatory cases of typhoid. The ileum was the common site of perforation, the majority occurring within twelve inches of the ileocæcal valve; the appendix and colon, respectively, were the most frequent sites of perforation.

Bacteriological examination of the peritoneal fluid was an aid to prognosis. Blood examination was important in making a diagnosis of typhoid fever.

All the cases were drained except the one in which no perforation was found. Incision in the outer border of the right rectus fascia was made in each case. In one case the pus was mopped out and drainage effected through a stab wound. He recommended the Murphy method in treating many of this class of cases, with accumulations of pus, large or small, particularly where there was not much fæcal extravasation.

SOME OLD FALLACIES IN RETROVERSION SURGERY REVIVED

DR. ALBERT GOLDSPOHN, of Chicago, in a paper on this subject, said it was an anatomical fact that the round ligaments of the uterus, irrespective of what might be their normal function ordinarily, were the only available means or medium for a harmless and permanent cure of retroversion in fruitful women, because they alone among the various uterine attachments were a part of the uterus itself and as such underwent evolution and involution with that organ during and after gestation. Years of abundant clinical experience had set forth the great value practically of this anatomical fact. This experience had been dearly paid for by numerous shameful parturient deaths from dystocia following vicious surgery for a minor ailment that, in itself, would never cause death. Nevertheless, two articles had recently appeared that rather ignored the above-mentioned experience, and advocated principles and procedures which gynecologists had thrashed out and discarded as old straw some time ago.

TYPHLITIS

DR. JOHN A. LYONS, of Chicago, stated that all cases of typhlitis and perityphlitis need not necessarily be secondary to appendicitis. He reported a case of abscess of the cæcum in support of this claim. The patient, aged 16, had suffered for several months from what were supposed to be recurrent attacks of appendicitis, and during the last one, in November, 1907, the speaker was called in and found the patient had suffered (1) from sudden severe abdominal pain; (2) nausea and vomiting; (3) general abdominal sensitiveness over the appendix; and (4) elevation of temperature to 102° F., soon after the onset of the severe pain. These were Murphy's cardinal symptoms of appendicitis, and making a diagnosis of appendiceal abscess because of a large fluctuating mass involving the entire iliopsoas region, the patient was ordered to hospital and after a hurried preparation the author made an incision over the tumor, when, to his surprise, he found a large abscess of the cæcum. The appendix was in its usual position and apparently normal in every respect, excepting where it was about to be involved at its extreme distal end in the perityphlitic inflammation. After cleaning out the abscess cavity, cutting away all gangrenous, loose, and raw edges, he removed the appendix, which, upon examination, proved to be normal, except as above noted.

A peculiar feature followed the operation, in that the patient, who had suffered from childhood with enuresis, wetting the clothes both night and day, had been entirely relieved of this annoying condition, it not having recurred, whereas it was frequent in occurrence before the operation. The author accounted for the cure of the enuresis by saying that ganglionic sympathetic fibers joined to the fourth sacral nerve, which latter supplied the neck of the bladder, must have been released from abnormal pressure by the complete cure of the inflammatory product.

REPAIR RATHER THAN REMOVAL OF THE GENERATIVE ORGANS OF WOMEN

DR. JOHN E. CANNADAY, of Charleston, West Virginia, discussed the advisability of trusting pelvic inflammation, especially that of the gonorrhœal type, to nature, and treating the results of infection by operation, if need be, later. He spoke of the need for treating certain cases of infection in accordance with the social condition of the woman. The time requirements of palliative treatment were being extended. He pointed out the advantages of not operating until physiological resistance to infection had been well established. Much of the so-called palliative treatment was useful only as a means of diverting the mind of the patient. Subinvoluted prolapsed organs after suspension and perineorrhaphy would, as a rule, be speedily restored to normal size by the relief of congestion incident to malposition. Local infections might be best attacked by local applications. Repair rather than removal was to be commended in general.

EXPERIMENTS UPON ANIMALS RELATIVE TO THE QUESTION OF ABDOMINAL SUPPORTERS AFTER LAPAROTOMY

DR. ROBERT T. MORRIS, of New York, described a series of experiments which he conducted upon animals which showed that it was unnecessary to subject patients to the annoyance of abdominal supporters so frequently as was commonly proposed. The author did not employ them in one per cent of his laparotomies.

The following papers were also read: "Factors of Safety in Abdominal Operations, Based on Operations," by Dr. Geo. W. Crile, of Cleveland, Ohio; "Report of a Case of Gastric Tetany; Operation; Recovery," by Drs. John Young Brown and William Engelbach, of St. Louis, Missouri. (See paper, p. 558).

OFFICERS

The following officers were elected for the ensuing year: *President*, Dr. William H. Humiston, of Cleveland, Ohio; *First Vice-President*, Dr. James Edgar Sadlier, of Poughkeepsie, New York; *Second Vice-President*, Dr. William A. B. Sellman, of Baltimore, Maryland; *Secretary*, Dr. William Warren Potter, of Buffalo, New York, re-elected; *Treasurer*, Dr. X. O. Werder, of Pittsburgh, Pa., re-elected.

Fort Wayne, Indiana, was selected as the place for holding the next annual meeting; time, third Tuesday in September, 1909.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF SURGERY

UNDER THE CHARGE OF

JOHN B. MURPHY, M. D.
FREDERIC A. BESLEY, M. D.
WM. C. DANFORTH, M. D.
AIMÉ PAUL HEINECK, M. D.
E. WYLLYS ANDREWS, M. D.
WM. R. CUBBINS, M. D.
M. G. SEELIG, M. D.
GEO. E. BEILBY, M. D.

The Operative Treatment of Embolism of the Pulmonary Artery. F. TRENDELENBURG, Leipzig., *Zentrablatt f. Chirurgie*, 1908. Vol. XXXV, p. 3.

Operative treatment is indicated when the diagnosis is certain and there is sufficient time.

Of 9 cases at the Leipzig hospital 2 ended fatally within 1-2 minutes; in the other 7 cases, ten minutes to one hour elapsed before the patients succumbed. In at least half of the cases there will be 15 minutes at the disposition of the operator.

Technique of Operation. — Opening of thorax by a transverse incision over second rib and a vertical incision over the left sternal border. The triangular flap is pulled back and the part of the second rib next to the sternum is resected for 10-12 cm. The extraction of emboli from the compressed and incised pulmonary artery must be done as quickly as possible. If more than 45 seconds are needed the artery may be clamped laterally, the compression loosened, and the blood-stream let through; again compressed and the search for emboli continued. In a specimen from a calf which had been operated upon four months previously for embolism of the pulmonary artery, a circumscript slight thickening was seen at the point of incision. The healed-in silk threads were invisible being covered by thickened connective tissue.

An attempt to perform the operation upon a seventy-year-old woman failed; the patient died before the operation was finished. FREDERICK G. DYAS.

Treatment of Non-Congenital Inflammatory Strictures of the Rectum. (Traitement des rétrécissements inflammatoires non congénitaux du rectum.) LESOURD. *Archives générales de Chirurgie*, March, 1908.

Lesourd describes and discusses different procedures employed in the cure of rectal stenosis. Rapid dilatation, and rectotomy are blind, dangerous procedures which do not prevent recurrences. Rectoplasty is an in genious method but it is difficult to practice, owing to the sclerotic perirectal infiltration. Sigmoidorectotomy has numerous advocates, but it is an operation of difficult execution and in a sense only palliative. By it one goes around the obstacle but does not act upon the stenosis itself. All these procedures have a common shortcoming. They act upon the rectal stenosis but they have no action upon the rectitis, and we all know how painful for the patient is the escape per anum of the purulent exudate. To act at the same time upon the stenosis and upon the rectal suppuration, three methods of treatment have been described:

1. Slow and progressive dilatation with copious rectal irrigations. This is applicable to superficial lesions. It must be incessantly repeated.

2. Colostomy, temporary or permanent. It prevents the existence of intestinal obstruction, it suppresses the pain and palliates the proctitis, especially if it be associated with exclusion of the rectum.

3. Extirpation of the rectum with preliminary anus, constitutes the procedure of choice and the author favors it. Other routes have been proposed to remove the rectum; the sacral of Kraske, the perineal of Quénu, and the abdominoperineal, the vaginal, and the anal route of Quénu-Segond. This consists in extirpating the intra-sphincteric portion of the rectum. The rectum is then amputated as high as possible and its upper extremity is sutured to the anus. The operation thus conducted assures perfect continence, enables one to reach high-placed stenosis and cures the proctitis. It is the only operation for rectal stenosis which assures a radical and a permanent cure.

Duverger, in the same Journal, reports a case of hypertrophic tuberculosis of the rectum. Symptoms of intestinal occlusion developed; an artificial anus was created. Ascites was present; in the rectal wall tuberculous granulations were present; there were no ulcerations on the mucosa. The case was one of rectoperitoneal tuberculosis.

Holland in the same number reports a case of tuberculosis of the sigmoid. The patient had for years been obstinately constipated and the stools were very dark in color. In the sigmoid region a tumor the size of a fist could be palpated. At the first operation, the condition was thought to be an inoperable carcinoma. An iliac colostomy was performed. Patient improved. Later, symptoms recurred. Another operation was performed. The sigmoid and its meso were removed. Cure. The microscopical examination showed that the lesions were tuberculous in nature.

AIMÉ PAUL HEINECK.

Osteoplasty. BARTH, Danzig., *Zentralbl. f. Chir.*, 1908. Vol. XXXV, p. 35.

Clinical as well as experimental experience shows that the periosteum upon periosteal bones may be successfully transplanted and that it possesses a high vitality and productivity.

In a 21-year-old male patient 20 cm. were resected with the periosteum for periosteal sarcoma, and supplanted by a corresponding piece of sterilized humerus of a skeleton. Course favorable at first; after 3 weeks fever and suppuration; implanted bone was removed 7 weeks p. op.; 3 mo. later splitting of the scar and implantation of a piece of sterilized fibula of a fresh corpse. Healing with osseous union at the upper and pseudarthrosis at the lower end. Fistula formation and removal of the bone 7 mo. later. After healing of the wound autoplastique with a 20-cm.-long splinter of the tibia with the periosteum. Osseous union with both humerus stumps after 2 years, but pseudarthrosis in the middle as a result of rarefication, whilst the implanted bone-piece had adapted itself to the form of the humerus in the other parts.

In a 33-year-old female patient 10 cm. of the upper tibia were resected for periosteal sarcoma. Fibula was implanted into the fossa intercond. fem. and defect between cond. int. fem. and stump of tibia supplanted by a macerated piece of the spongiosa. Incomplete consolidation amputation 1½ years later for recurrence of the sarcoma. The implanted spongiosa-piece was found much diminished; the union with tibia was osseous.

With the same method, but using two periosteum-covered bone-pieces from the sound tibia, B. effected a perfect result in a 17-year-old girl with myelogenous sarcoma of the head of the tibia. Complete consolidation, walking free, without relapse after 4 years.

An ideal result had B. in an 8-year-old boy with a 6-cm. circular defect of the tibia after osteomyelitic total necrosis. Implantation of two periosteal splinters of the sound tibia. Complete consolidation with osseous new formation after 2½ years; perfect function of the leg.

In another case of autoplasty which was performed 6 years ago for a 6-cm.-long resection of the tibia for sarcoma, the functional result was imperfect on account of pseudarthrosis at the lower end. X-ray picture showed hardly any difference with the sound tibia.

In complicated scull fractures B. sterilizes the soiled fragments by boiling them and replants same. In one case he had a good result by secondary healing in of bone charcoal into the granulating wound.

17-year-old girl suffering since her 5th year of age of the most terrible deformities of the extremities as a result of osteomalacy, so that she could only move by crawling on the ground, had been osteotomized several times without result, as there remained pseudarthrosis. By implantation of bone charcoal into the marrow cavities, consolidation was effected inside of 10 weeks. One after another 6 osteotomies with implantation of bone charcoal were thus performed and the girl can walk.

FREDERICK G. DYAS.

A New Method of Local Anaesthesia Applicable to the Extremities. PROFESSOR DR. AUGUST BIER.

Prof. Bier presented to the German Surgical Congress in April, 1908, a new method which he has devised for local anæsthesia applicable to the extremities. He makes use of an entirely new principle, namely, the utilization of the blood vessels as the medium of injection and distribution of the anæsthetic solution. The method is highly interesting from a physiological standpoint and I have no doubt will prove of value in certain cases. Briefly, his method is as follows: The limb to be operated upon is first rendered bloodless by the application of an Esmarch elastic bandage while the limb is held in an elevated position. A tourniquet is then applied tightly above and below the proposed field of operation. Under infiltration anæsthesia a principal vein or one of its tributaries is exposed in the distal portion of the operation field and its lumen opened by a small longitudinal incision. In operations upon the knee-joint, for instance, the internal saphenous vein is made use of. A cannula is then introduced in the vein and made secure and from 50 to 100 c.c. of ¼ or ½ of one per cent novocain solution is introduced, the injection of the solution being made under considerable pressure. The solution is thus carried through the veins and capillaries all the tissues, including periosteum and bone, which lie between the proximal and distal tourniquets. In from three to five minutes complete anæsthesia is obtained which continues for a length of time sufficient to perform any operation. At the completion of the operation the novocain solution is allowed to escape from the vein and the vein may be washed out with saline solution. As an extra precaution the proximal tourniquet is released sufficiently to allow slight venous bleeding and thus the solution remaining free in the veins is washed out. This method of anæsthesia has the advantage of being applicable to any operation upon the limbs where a segment may be thus anæsthetized. Properly employed it is apparently without danger. But we should bear in mind that the quantity of drug used amounts to a toxic dose if allowed to enter the general circulation.

It was my privilege, while in Berlin this summer, to witness in Prof. Bier's clinic the application of this method in two cases of resection of the knee-joint for tuberculosis. In each instance anæsthesia was complete, the patients stating that they were insensible to any pain. There was apparently no shock and no toxic spmptoms.

In the *Archiv. für Klinische Chirurgie.*, Band 86, Heft 4, p. 1007, Professor Bier gives a description of the method and reports two cases in which he first applied it. One was for the resection of a tuberculous elbow joint and the other for the removal of a sequestrum of bone following an osteomyelitis of the radius. Anæsthesia was satisfactory in both instances. At the time of making this report Bier had but once encountered any poisonous effects attributable to the novocain solution, and in this instance they were not severe.

The advantage of local anæsthesia in certain cases

is well recognized and I believe this new method of Bier's will prove a valuable contribution to the subject.

GEORGE E. BEILBY.

Renal Suppuration in Typhoid Patients. (Les suppurations pyélo-rénales chez les typhoïdiques). R. PAGEOT. *Archives générales de Chirurgie*, April, 1908.

In the course of typhoid fever, the kidney and its pelvis can become the seat of spreading suppurative inflammation. Miliary abscesses, pyonephrosis, pyelonephritis with or without distension are among the most common of these processes. Small miliary abscesses develop unrecognized, the clinical picture being that of ordinary nephritis. Pyelonephritis without retention manifests itself chiefly by urinary modifications: pus, red blood corpuscles, gases. Slight and transitory lumbar pains are not infrequent.

Each clinical form demands that it be differentially diagnosed. Pyelonephritis must be differentiated from cystitis. Pyeloneephritis with retention must be differentiated from splenic or cystic pus accumulations.

These conditions are not due exclusively to the bacillus typhosus, they may be due to the ordinary pus microbes penetrating into the general circulation by way of the intestinal ulcers. In the absence of symptoms referable to the urinary bladder or of pre-existing lesions of this organ, these suppurative pyelonephritic processes are due to a vascular or descending infection.

AIMÉ PAUL HEINECK.

Therapy of Actinomycosis. FOEDERL, Vienna. *Zentralbl. f. Chir.*, 1908, Vol. XXXV, p. 45.

F. reports six cases of actinomycosis, which apparently were cured by injections of natr. kakodylikum. The infection originated always from the cavity of the mouth with localization of the abscesses and infiltration on the tongue, the neck with perilaryngeal spreading, in the regio temporalis with spreading to the base of the skull and of the lower jaw with spreading to the submaxillary glands.

On the first day was a 10 per cent watery sol. intramuscularly in the nates ½ of a Proraz syringeful injected, increasing each day ½ syringeful until a full syringeful is given during one week, and then decreasing the quantity to the ½ syringeful and then commencing over.

With this general treatment the local measures are confined to puncture or little incisions for abscesses. More extensive operations are avoided. The author recommends for cases in which good results have not followed the use of sodium iodide to use sod. cacodylate.

FREDERICK G. DYAS.

Post-operative Thrombosis and Embolism. RANZI, Vienna. *Zentralbl. f. Chir*, 1908. Vol. XXXV, p. 8.

Reports of 6,871 operations during the last 7 years at von Eiselsberg's clinic show 263 lung complications and amongst these 57 embolic affections.

Frequent causes are the diseases of the muscles of the heart, and therefore R. advises preparation of patient before greater operations with heart remedies (digalen), and the application of ether for the continuation of the anæsthesia. Early leaving the bed after operations he considers as not recommendable, because only few cases were observed in which embolism followed after a longer bed-rest after operations, and on account of the danger of hernia of the intestines. 23 cases of embolism were observed 5 days p.o. In protracted cases of pulmonary embolism the indication for operation is doubtful as one effects now and then a result by excitants. The most favorable condition for operation is when the embolus is in the branch of the main trunk of the pulmonary artery.

FREDERICK G. DYAS.

Clinical Forms of Cancer of the Large Intestine. (Les formes cliniques du cancer du gros intestin). GEINPUY. *Archives générales de Chirurgie*, March, 1908.

Owing to the variability of its location and to its pathological anatomy, owing to the relation which it bears to the abdominal organs, the clinical manifestations of cancer of the large intestine are variable.

1. The author differentiates a diarrhœic type, especially frequent in cancers of the right half of the large intestine, in which we have a profuse, tenacious, non-intermittent, and continuous diarrhœa in which we have a profound alteration of the general state and a tumor readily and early detected.

2. A dyspeptic form in which the patient complains of the gastric phenomena, loss of appetite, painful digestion, vomiting. In this form the intestinal symptoms are often very indefinite. The symptoms are due either to reflex action or to stercoræmia. This form is often found in cancer of the cœcum.

3. A gastric form where the symptomatology is that of cancer of the pylorus. This form is found especially in cancers of the right half of the transverse colon. The best way to make a differential diagnosis between the two localizations, is by the aid of buccal and of rectal insufflations.

4. A form with constipation and obstruction. This is the best known form. It is the one which we always expect to find when we think of the possibility of cancer of the large intestine. It is especially found in cancers of the lower portion of the colon and of the sigmoid colon. It usually coincides with preservation of good general state. The tumor is usually difficult to diagnose previous to operation. Search for it must be made diligently.

5. A form of occlusion. Symptoms of intestinal obstruction are the first signal that we are dealing with a grave disease, but careful questioning of the patient will reveal some data suggestive of previous interference with the intestinal circulation.

6. A type characterized by weakening of the general state, at times manifesting itself by cachexia, at times by anæmia.

7. An inflammatory form having either a simple acute inflammation without an exudatory collection, or with an encysted collection, or with a generalized peritonitis secondary to rupture.

AIMÉ PAUL HEINECK.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF OBSTETRICS

UNDER THE CHARGE OF

C. S. Bacon, M. D. — Rudolph W. Holmes, M. D.
C. v. Bachellé, M. D. — Hugo Ehrenfest, M. D.

Permanent Enlargement of Contracted Pelves. (Die bleibende Erweiterung für des engen Beckens.) G. Schickele. *Zentralblatt für Gynäkologie, No. 17, 1908.*

Schickele declares that hebosteotomy only temporarily enlarges the pelvis and that when healing is complete, the woman still retains her contracted pelvis, and, therefore, the question arises as to whether or not permanent enlargement cannot be made in some way, so that in subsequent labors, the woman need not be again subjected to operation. Several surgeons have already described or attempted operations for relief of pelvic stenosis with more or less success, and these are outlined in Schickele's article. His own technique, which he describes in detail, is as follows: An incision is made on the upper border of the horizontal ramus of the pubic bone from 3–5 cm. long, the center of the incision being opposite the tubercle of the pubic bone, and this is carried down to the bone and through the periosteum. The latter is carefully separated from the bone and the posterior and anterior surfaces of the ramus. The finger is inserted between the periosteum and the bone posteriorly and guides the Döderlein needle which emerges anteriorly and close to the lower edge of the descending ramus and is cut down upon and receives the Gigli saw. The wound edges are held apart to prevent their being cut by the saw and then for 5 or 6 strokes the saw cut is made at right angles to the posterior surface of the bone, then the angle of the bone incision is changed so that it parallels the anterior and posterior surface of the bone for about 2 cm. or until pretty close to the symphysis, when it is again turned parallel to the first incision and emerges on the anterior surface of the pubis. After the incision, the bone ends gape a space of 3 finger breadths. There is but moderate bleeding and the soft parts are carefully sutured. After the delivery, the woman is placed on her back with the knees slightly flexed over a round pillow and with the thighs abducted. In the case reported, the patient did well and in seven weeks, the thinned lamellæ of the pubic bone could no longer be discerned and the sensation to the palpating finger was as though the bones had been divided in a straight transverse cut. There was some mobility to the union, for, when the thighs were brought together, one finger could be introduced between the ends of the bones and with abducted thighs, two fingers could be interposed. Locomotion was not disturbed and the patient has no symptoms whatever.

C. v. Bachellé.

A Case of Coxa Vara Congenita. (Ein Fall von Coxa vara congenita.) (*Wien klin. Wchnschr.*, 1908, *xxi*, 1358.)

V. Frisch reports a case of coxa vara congenita in a little girl, and states that there are more than 30 other cases reported in the literature. He disagrees with Hoffa's theory of a deficiency of "bioplastic energy" in the epiphysis of the head of the femur as the cause of the disease. He states that the vertical position of the epiphysis at the femoral head as well as its frequent forking may be conceived to be a disturbance of ossification, that the slowly advancing border of the bony-cartilaginous area of the shaft does not adapt itself to the varus position of the cartilaginous femoral head, and that the deficiency in the calcification of the diaphysis of the lower half of the neck of the femur gives rise to an atypical ossification. This latter in turn may cause the appearance of another nucleus of ossification.

C. G. Grulee, M. D.

Menstruation and its Relationship to the Calcium Metabolism. W. Blair Bell, M. D. Reprint from the "Proceedings of the Royal Society of Medicine," July, 1908.

In 1907 this author published a work entitled "Calcium Salts in the Blood and Tissues" (Brit. Med. Jour., 1907, No. 1, p. 920), on which as a basis he now goes into the study of a special function. His work along this line has consisted of prolonged experimental research and clinical observation, under the patronage of the Scientific Committee of the British Medical Association. The present article gives little detail and no statistics, but is rather a preliminary sketch of what has been accomplished. The chief interest, therefore, will lie in such conclusions as have already been drawn, e. g.:

Menstruation is a periodic function only in so far as the rest of calcium metabolism is in harmony with this periodicity, and the function is dependent upon the calcium metabolism in all its ramifications.

The hæmorrhage into the Graafian follicle may be coincidental and is the result of the lowered calcium content of the blood, but it is in no way responsible for menstruation.

The bleeding from the uterus, while due to the lowered calcium content of the blood in the main, is also dependent on the local change in the capillaries from which the diapedesis of leucocytes and corpuscles occurs, and, further, these leucocytes are an active factor in the conveyance of calcium salts from the glands to the exterior.

The uterine glands excrete calcium and mucin, and therefore the uterus is a "menstrual organ."

There is a correlation between the ovaries and uterus in reference to menstruation, but the ovary is probably no more predominant than other ductless glands in this respect.

Menstruation *per se* is not a necessary adjuvant or concomitant to fertility and reproduction.

CAREY CULBERTSON.

Extraperitoneal Cæsarian Section. (Für den extraperitonealen Kaiserschnitt.) F. FROMME. *Zentralblatt für Gynäkologie, No. 17, 1908.*

Fromme declares that this operation is not intended to supersede the classical Cæsarean section but only draws more closely the bounds of the indication for it, reserving it for those cases of contracted pelvis in which certainty of asepsis exists — such cases must have entered the hospital 14 days before labor and are not examined internally after that and the section made when labor pains have begun. Contrasted with these are those cases which have the ordinary indications for Cæsarean section but which have been examined vaginally shortly before labor has begun or during its progress. In such one cannot be sure of asepsis and the results, too often, are bad. Therefore, in such cases, this substitute is used, regardless as to the presence of fever or not. He also believes that the operation will, in the future, crowd out the operations for dilating the pelvic inlet in cases of primiparæ where, in spite of prolonged strong pains with fully dilated cervix, the head does not descend and some indication for rapid delivery exists. Here the results of hebosteotomy cannot be predicted with certainty, but in the extraperitoneal Cæsarean section we have an exact surgical procedure. Besides this, it has a place in cases of unusual obstruction of the birth canal and in threatened rupture of the uterus with living child, also in cases of transverse presentation.

The technique is as follows: A median incision of about 12 cm. long is made through all layers of the abdominal wall. The uterine peritoneum is then split in the median line from the vesicouterine fold up as far as it is movable on the uterine surface, which is usually from 10–12 cm. Then these flaps of uterine peritoneum are sewed to the corresponding edges of the parietal peritoneum. The uterus is then split longitudinally, the delivery made, and all the layers restored by suture as before the operation. He believes that the greatest danger lies in allowing the entrance of amniotic fluid, blood, etc., into the abdominal cavity to furnish pabulum for the saprophytic germs which otherwise would be destroyed by the peritoneum and that this method ensures the exclusion of such material.

C. V. BACHELLÉ.

Decapsulation of the Kidneys in Puerperal Eclampsia. (Nierendekapsulation bei puerperaler Eklampsie.) R. ASCH. *Zentralb. f. Gynak.*, 1908, No. 9, p. 283.

Asch here reports his second successful case of decapsulation of the kidneys for puerperal eclampsia. The patient, 21 years of age, was spontaneously delivered three days before coming into the hospital. The puerperium began normally, without rise of temperature until the third day, when a three-minute convulsion occurred. Others equally severe came on with increasing duration at intervals of 45 to 30 minutes. Urine obtained by catheter gave an abundant albumin reaction. Coma persisted between the attacks, growing deeper until there was a loss of the corneal reflex. The face was œdematous, and a few shorter convulsions were observed during the chloroform anæsthesia used in the operation. The decapsulation was attended by no particular difficulty, and at once following the patient sank into a quiet sleep, respirations becoming softer and more regular, the convulsions ceasing altogether. The albuminuria disappeared in two weeks and the patient left the hospital on the 28th day in good condition.

CAREY CULBERTSON.

Lysol Poisoning from Intrauterine Irrigation. (Lysol Vergiftung bei Intra-uterine Ausprülung). W. PILTZ, M.D. *Münich Med. Wochenschrift, June 16, 1908.*

Lysol came into use in 1889 and has been used very extensively in Gynecologic and Obstetric practice, because of its alleged non-toxicity and strong bactericidal power. However, many authors have reported fatal cases of lysol poisoning. This poisoning is characterized by symptoms of acute hæmorrhagic nephritis, acute cerebral, and acute peritoneal irritation, and, especially, by the presence in the urine of phenol and tribromphenol. It has occurred after 1 per cent lysol uterine douching. Craemer and Hammer believe that lysol enters the circulation through the gaping intrauterine veins and by way of the periuterine venous plexus. They declare it to be a hæmotoxic and cytotoxic substance.

The author doubts that a 0.5 per cent – 2 per cent solution of lysol is able to injure healthy kidneys, but he warns against its indiscriminate use, especially in cases with suspected renal lesions. The prognosis is good; the patients recover completely, showing that there was only a glomerulo-nephritis like the one due to toxins of scarlet fever.

J. F. HULTGEN.

Two Cases of Prolapse of the Uterus in the Virgin. A. MCLELLAN, M. D., Glasgow. Case report, Glasgow Obstetrical and Gynæcological Society, Jan., 1908. *Jour. Obstet. and Gynaec. of the Brit. Emp.*, March, 1908.

1. A girl of 16 years of age, seen first in February, 1906, had four weeks previously noticed a swelling of the vulva which had gradually increased in size. There was no pain, but a certain amount of backache. On examination the uterus and vaginal walls were prolapsed outside the vulva. There was no cervical hypertrophy and no history of occupation having caused the prolapse — her work had always been easy. The prolapse was easily reduced and the uterus was kept in position by a ring pessary.

2. The second patient suffered from prolapse of a less degree than the first, was 32 years of age, unmarried and nulliparous. The prolapse was due to a dermoid tumor of the right ovary, and was of nine months' duration. The ovarian dermoid was removed by laparotomy and the prolapse thereby cured.

As a result of his dissections of the pelvic floor, McLellan is disposed to agree with Fothergill that the pelvic floor is of little use in preventing prolapse of the uterus. He believes that the cellular tissue in the bases of the broad ligaments constitutes the important factor in uterine support. In neither of the cases here reported was there any relaxation of the pelvic floor.

CAREY CULBERTSON.

BOOK REVIEWS

UEBER SALPINGITIS NODOSA. By Von Dr. Rudolf Maresch, Prosekturadjunkt der k. k. Krankenanstalt "Rudolfsstiftung" in Wien. Mit 17 Abbildungen im Text und zwei Tafeln. Verlag von S. Karger, Berlin, 1908.

This work is a monograph of 75 pages, based on the examination of serial sections of tubes in six cases, and also on a study of injection preparations. From its pathologic side the subject is very thoroughly presented, but the author makes no attempt to consider in detail its every phase. A few microphotographs and two pages of colored plates are of much aid in a clear understanding of the text. The author closes with two pages of conclusions relative to his pathologic findings, and eventually states that the term "salpingitis nodosa" is a proper designation, though he suggests that "interstitialis" or "isthmica" may be added according to the seat of the lesion. He further argues that, since he found no true neoplastic formations, the term "adenomyom," as applied to this particular entity, is unfitting.

CAREY CULBERTSON.

MEDICAL GYNECOLOGY. By S. Wyllis Bandler, M. D., Adjunct Professor of Diseases of Women, New York Post-Graduate Medical School and Hospital. Octavo, 600 pages, with 13 original illustrations. Cloth, $5.00, net. Half Morocco, $6.50, net. Philadelphia and London: W. B. Saunders Company, 1908.

This volume is an entirely new work by this author, and it comes at a time when the practitioner of medicine is voicing the need for a treatise on gynecology not given over entirely to operative treatment. In this instance, Dr. Bandler has not confined his text to conservative treatment alone, but has combined with this an accurate exposition of the normal and pathologic genital functions and the relation of these functions to the general physical and psychic health of woman. The classification is not on a pathologic basis so much as on a clinical one, the various topics being viewed from the standpoints of the symptoms, the disease, the bimanual and the microscopic findings, and the general physical and nervous state. The volume has thus been prepared especially for the general practitioner. One valuable point noticed as well is that, while those conditions amenable to non-operative treatment are dealt with, the physician is also taught how to recognize those diseases demanding operative treatment. This is an important point, and one sometimes overlooked in authoritative works. The chapter on Gonorrhœa is one deserving especial mention, this subject having been never so well presented aside from elaborate monograph presentation. Other chapters that are particularly well written are those on the pessary, on massage, and on the associated nervous conditions in gynecology. Pregnancy and abortion is very properly considered in its relation to the general subject, and a section on artificial hyperæmia and anæmia gives the last word in this new therapy.

CAREY CULBERTSON.

BOOK RECEIVED

PARAFFIN IN HERNIA. By Charles C. Miller, M. D., Chicago. Oak Printing Company, 1908. Price, $1.00

Fig. 1. Showing the relation of the biliary and pancreatic ducts to the head of the pancreas and duodenum.